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Data Summary Report:
2011 Residential Activity-Based Sampling
Libby Asbestos Superfund Site, Operable Unit 4
Libby, Montana

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List of Acronyms and Abbreviations

%	percent
ABS	activity-based sampling
Ago	area of a grid opening
ATV	all-terrain vehicle
C	concentration
CB&I	CB&I Federal Services, LLC
cc	cubic centimeter
CDM Smith	CDM Federal Programs Corporation
CH	Chrysotile
CHISQ	Chi-square
CUA	common-use area
DQA	data quality assessment
EDD	electronic data deliverable
EDS	energy dispersive spectroscopy
EDXA	energy dispersive x-ray analysis
EFA	effective area of the filter
EPA	U.S. Environmental Protection Agency
ESAT	Environmental Services Assistance Team
F	fraction of primary filter deposited on secondary filter
FBAS	fluidized bed asbestos segregator
FSDS	field sample data sheet
FTL	field team leader
GO	grid opening
GPS	global positioning system
HV	high volume
ID	identification
L	liters
LA	Libby amphibole
LUA	limited-use area
LV	low volume
MCE	mixed cellulose ester
min	minute
mm	millimeter
mm^2	square millimeters
N	number of asbestos structures counted
NAM	non-asbestos material
ND	non-detect
OA	other amphibole
OU	Operable Unit
PCME	phase contrast microscopy-equivalent
PLM	polarized light microscopy

List of Acronyms and Abbreviations, continued

PLM-VE	polarized light microscopy visual area estimation
PLM-Grav	polarized light microscopy gravimetric
QA	quality assurance
QATS	Quality Assurance Technical Support
QC	quality control
RESI	Reservoirs Environmental
ROM	record of modification
s/cc	structures per cubic centimeter of air
S	analytical sensitivity
SAED	selected area electron diffraction
SAP	sampling and analysis plan
Site	Libby Asbestos Superfund Site
SPF	Sample Preparation Facility
SOP	standard operating procedure
SUA	specific-use area
TAS	target analytical sensitivity
TEM	transmission electron microscopy
µm	micrometers
V	volume
VV	visible vermiculite
VWC	volumetric water content

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1 INTRODUCTION

1.1 Site Background

Libby is a community in northwestern Montana located 7 miles southwest of a former vermiculite mine that operated from the 1920s until 1990. The mine began limited operations in the 1920s and was operated on a larger scale by the W.R. Grace and Company from approximately 1963 to 1990. Studies revealed that the vermiculite from the mine contains amphibole-type asbestos, referred to as Libby amphibole (LA).

Epidemiological studies revealed that workers at the mine had an increased risk of developing asbestos-related lung disease (McDonald *et al.,* 1986, 2004; Amandus and Wheeler 1987; Amandus *et al.,* 1987; Whitehouse 2004; Sullivan 2007). Additionally, radiographic abnormalities were observed in 17.8 percent (%) of the general population of Libby including former workers, family members of workers, and individuals with no specific pathway of exposure (Peipins *et al.,* 2003; Whitehouse *et al.,* 2008; Antao *et al.,* 2012; Larsen *et al.,* 2010, 2012a, 2012b). Although the mine has ceased operations, historic or continuing releases of LA from mine-related materials could be serving as a source of ongoing exposure and risk to current and future residents and workers in the area. The Libby Asbestos Superfund Site (Site) was listed on the U.S. Environmental Protection Agency (EPA) National Priorities List in October 2002.

1.2 Document Purpose

As determined by previous investigations conducted at the Site, LA is present in multiple environmental media in Libby. However, asbestos fibers in source materials are typically not inherently hazardous, unless the asbestos is released from the source material into air where it can be inhaled (EPA 2008). If inhaled, asbestos fibers can increase the risk of developing lung cancer, mesothelioma, pleural fibrosis, and asbestosis. Thus, the evaluation of risks to humans from exposure to asbestos is most reliably achieved by the collection of data on the level of asbestos in breathing zone air during disturbance of asbestos source materials, referred to as "activity-based sampling" (ABS) (EPA 2008).

In 2011, the EPA conducted several residential ABS investigations in Operable Unit 4 (OU4) to evaluate potential exposures from the disturbance of yard soils at residential properties in Libby. OU4 encompasses the residential and commercial properties in Libby. These residential ABS investigations consisted of four different sampling scenarios. The specific objectives and study designs of each sampling scenario are described in the governing sampling and analysis plan (SAP), *2011 Residential Activity-Based Sampling SAP* (CDM Smith 2011). Four sampling scenarios were performed to evaluate potential LA exposures to residents who perform yard work:

- Scenario 1: This scenario evaluated potential differences in measured ABS LA air concentrations as a function of the ABS scripts used to perform the raking, mowing, and digging disturbance activities.

- Scenario 2: This scenario was a replication of the outdoor ABS yard investigation conducted in 2010 to evaluate potential differences in measured ABS LA air concentrations at a given property across sampling years.

- Scenario 3: This scenario evaluated potential differences in measured ABS LA air concentrations during mowing activities that were conducted on yards pre- and post-irrigation.

- Scenario 4: This scenario evaluated potential LA exposures at residential properties where previous soil removal activities occurred over the entire yard (i.e., curb-to-curb removal).

In addition, the EPA conducted an investigation of limited-use areas (LUAs) (e.g., pastures and maintained fields) in OU4 to evaluate potential LA exposures while riding all-terrain vehicles (ATVs) in LUAs at residential properties in Libby. The specific objectives and study designs of this sampling scenario are described in the governing SAP, *2011 Miscellaneous Activity-Based Sampling SAP* (CDM Smith 2012a). For the purposes of this report, the LUA scenario is referred to as Scenario 5.

The study design of these sampling scenarios is described in greater detail in Sections 4 to 8. This document will summarize the results of each sampling scenario and provide an interpretation of the collected data. *[Note: The evaluation of potential risks is beyond the scope of this document. Human health risks from exposures to LA are evaluated in the Site-wide human health risk assessment.]*

1.3 Document Organization

In addition to this introduction, this report is organized into the following sections:

Section 2 This section summarizes data management procedures, including sample collection, documentation, handling, custody, and data management.

Section 3 This section summarizes the sample preparation and analytical methods used for estimating the level of LA in air and soil, and the data reduction methods utilized in this report.

Section 4 This section summarizes the data that were collected for Scenario 1 and includes an overview of the study design, presents the analytical results, and provides an interpretation of the collected data.

Section 5 This section summarizes the data that were collected for Scenario 2 and includes an overview of the study design, presents the analytical results, and provides an interpretation of the collected data.

Section 6 This section summarizes the data that were collected for Scenario 3 and includes an overview of the study design, presents the analytical results, and provides an interpretation of the collected data.

Section 7 This section summarizes the data that were collected for Scenario 4 and includes an overview of the study design, presents the analytical results, and provides an interpretation of the collected data.

Section 8 This section summarizes the data that were collected for Scenario 5 and includes an overview of the study design, presents the analytical results, and provides an interpretation of the collected data.

Section 9 This section presents the results of the data quality assessment, including a summary of program audits, modifications, data verification and validation efforts, an evaluation of quality control samples, and a data adequacy assessment.

Section 10 This section provides full citations for all analytical methods, site-related documents, and scientific publications referenced in this document.

All referenced tables and figures are provided at the end of this document. All referenced appendices are provided electronically upon request. A detailed summary of all sample information and analytical results for all samples presented in this document is provided in **Attachment 1**.

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2 DATA MANAGEMENT

2.1 Sample Collection, Documentation, Handling, and Custody

All samples generated as part of the ABS investigations were collected, documented, and handled in accordance with Libby-specific standard operating procedures (SOPs), as specified in the governing SAPs (CDM Smith 2011, 2012a).

2.1.1 Collection Methods

ABS Air

All ABS activities were performed by an EPA field contractor (CDM Federal Program Corporation [CDM Smith]) in accordance with the ABS scenario "scripts" provided in the SAP. The ABS script is what dictates how the sampling team conducts the ABS activity (i.e., what disturbance activities to perform, where they should be performed, how to conduct the activity, and for how long each activity should be performed). Personal ABS air samples were collected in accordance with SOP EPA-LIBBY-01. In brief, the ABS actor carries a battery-powered sampling pump in a backpack, with an air monitoring cassette attached to the pump via a plastic tube. The cassette is affixed to the actor such that the cassette is located within the breathing zone. All air samples were collected using cassettes containing a 25-millimeter (mm) diameter mixed cellulose ester (MCE) filter with a pore size of 0.8-micrometers (µm).

With the exception of Scenario 1, the ABS actor wore two different types of sampling pumps. The primary air sample was collected using a sampling pump operating at a high flow rate (5.5 liters per minute [L/min]), and is referred to as the "high volume" (HV) sample. A backup air sample was collected using a sampling pump operating at a low flow rate (2 L/min), and is referred to as the "low volume" (LV) sample. The HV and LV samples are filter replicates (i.e., each filter represents the same sample collection duration, but different total sample air volumes). The LV sample was analyzed in cases where the HV sample was damaged or overloaded (see Section 3.1.1 for additional information).

For Scenario 1, the ABS actor wore three pumps to allow for the collection of a HV and LV sample under the "high intensity" ABS script and a HV sample under the "low intensity" ABS script (see Section 4.1 for additional information on the study design for Scenario 1).

At the start of each sampling day, each air sampling pump was calibrated using a rotameter that had been calibrated to the primary calibration standard (i.e., a Bios DryCal® DC-Lite). During the ABS activities, pump flow rates were verified every 30 minutes and re-calibrated as appropriate.

Soil

Surface soil composite samples were collected and homogenized in accordance with SOP CDM-LIBBY-05. At the time of collection, each soil sub-sampling point was inspected for visible vermiculite (VV) and a qualitative estimate of VV was determined – none, low, moderate, or high – in basic accordance with the SOP CDM-LIBBY-06. A count of the number of sampling points assigned to each VV ranking was recorded on the field sample data sheet (FSDS) form for each soil sample (e.g., 18 none [X], 6 low [L], 4 moderate [M], 2 high [H]).

Soil Moisture Content

With the exception of the Scenario 3 "with irrigation" events, *in situ* soil moisture was measured before each sampling event using a soil moisture meter. For each ABS area, soil moisture was collected from a minimum of 10 locations between 0 and 3 inches below ground surface and the volumetric water content (VWC) was determined. ABS activities were not performed if the average VWC was greater than 30%, or if the VWC of any of the measurement points was greater than 50%.

For Scenario 3 "with irrigation" events, *in situ* soil moisture was measured before and after irrigation using the procedure described above, but ABS activities were conducted regardless of the measured VWC (see Section 6.1 for additional information on the study design for Scenario 3).

Vegetative Cover and Condition

A qualitative estimate of the extent of vegetative cover and vegetation condition of each ABS area was determined at the start of each sampling event. The extent of vegetative cover in the ABS area was assigned a score as follows:

Score	Vegetative Cover Extent
1	less than 5 percent cover
2	5 to 25 percent cover
3	25 to 50 percent cover
4	50 to 75 percent cover
5	more than 75 percent cover

Prior to the start of ABS activities, vegetative condition of the ABS area was qualitatively ranked as either sparse, good, or lush.

Meteorological Data

Meteorological data from the National Oceanic Atmospheric Administration station in Libby (LBBM8) and at the mine (ZONM8) were downloaded electronically from the MesoWest website[1].

2.1.2 Documentation, Handling, and Custody Methods

All ABS air and soil samples collected were identified with sample identification (ID) numbers that included a program-specific prefix of "EX-2" (e.g., EX-20001) for Scenarios 1-4 and "EX-3" (e.g., EX-30001) for Scenario 5. Data on the sample type, location, collection method, and collection date of all samples were recorded both in a field logbook maintained by the field sampling team and on an FSDS form designed to facilitate data entry into the Libby site database (see Section 2.4). All samples collected in the field were maintained under chain of custody during sample handling, preparation, shipment, and analysis.

2.2 Analytical Results Recording

Standardized data entry spreadsheets (electronic data deliverables, or EDDs) have been developed specifically for the Libby project to ensure consistency between laboratories in the presentation and submittal of analytical data. In general, a unique EDD has been developed for each analytical method and each medium. Each EDD provides the analyst with a standardized laboratory bench sheet and accompanying data entry form for recording analytical data. The data entry forms contain a variety of built-in quality control (QC) functions that improve the accuracy of data entry and help maintain data integrity. These spreadsheets also perform automatic computations of analytical input parameters and results (e.g., sensitivity, dilution factors, and concentration), thus reducing the likelihood of analyst calculation errors. The EDDs generated by the laboratories are uploaded directly into the Libby site database (see Section 2.4).

2.3 Hard Copy Data Management

Hard copies of all FSDSs, field logbooks, and chain of custody forms generated during this investigation are stored in the CDM Smith field office in Libby, Montana. **Appendix A** of this report provides copies of the field documentation for this investigation.

All analytical bench sheets are scanned and included in the analytical laboratory job reports. These analytical reports are submitted to the Libby laboratory coordinator (i.e., the EPA's Environmental Services Assistance Team [ESAT] contractor, TechLaw) and stored electronically. **Appendix B** of this report provides copies of all the analytical laboratory reports for analyses performed as part of this investigation.

[1] http://mesowest.utah.edu/

2.4 Electronic Data Management

Sample and analytical electronic data are stored and maintained in the Libby Scribe project databases which are housed on a local computer located at the TechLaw office in Golden, Colorado, which is backed up daily to an external hard drive. Raw data summarized in this report were downloaded from Scribe.NET on 1/9/2014, into a Microsoft Access® database by CDM Smith. A frozen copy of this Access database is provided in **Appendix C** of this report.

Because data for the Libby project are maintained in multiple Scribe projects (e.g., analytical data are managed in annual projects, field information is managed in a project separate from the analytical information), the data have been combined into one Access database reflecting a compilation of tables from multiple Scribe projects. Any changes made to these Scribe projects since this download will not be reflected in the Access database.

2.5 Personal Data Security

To ensure the personal data security of the home and business owners whose properties were sampled through the course of this investigation, information on residential/commercial property addresses is "masked" in this data summary report. Actual street addresses (e.g., 123 Main Street) are not shown; instead, properties have been assigned unique property identification numbers (e.g., AD-000543) and these identifiers are used to reference specific properties. Cross-referencing the property identification numbers to the actual street addresses is only possible through use of the Scribe project databases described in Section 2.4. These databases are only available to Scribe subscribers upon approval by the EPA.

3 SAMPLE PREPARATION AND ANALYSIS METHODS

3.1 LA in Air

3.1.1 ABS Sample Analysis Hierarchy

As noted previously, for most scenarios, each sampling event resulted in two ABS air samples – one HV sample and one LV sample. These samples are field replicates in that they were collected over the same sampling duration, but using different sampling pump flow rates (resulting in different total air sample volumes). The HV sample was analyzed in preference to the LV sample. If the HV sample was deemed to be overloaded (i.e., more than 25% particulate loading on the filter), the LV sample was analyzed in preference to performing an indirect preparation on the HV sample. If the LV sample was also deemed to be overloaded, an indirect preparation (with ashing) of the HV sample was performed in accordance with SOP EPA-LIBBY-08.

3.1.2 Analysis Method and Counting Rules

Air filters collected as part of this effort were prepared and analyzed for asbestos using transmission electron microscopy (TEM) in basic accordance with ISO 10312:1995(E) (ISO 1995), with all applicable Libby-specific laboratory modifications[2], including LB-000019, LB-000029, LB-000030, LB-000066, LB-000084, and LB-000085.

When a sample is analyzed by TEM, the analyst records the size (length, width) and mineral type of each individual asbestos structure that is observed. Mineral type is determined by selected area electron diffraction (SAED) and energy dispersive spectroscopy (EDS), and each structure is assigned to one of the following four categories:

LA Libby-class amphibole. Structures having an amphibole SAED pattern and an elemental composition similar to the range of fiber types observed in ores from the Libby mine (Meeker *et al.,* 2003). This is a sodic tremolitic solid solution series of minerals including winchite and richterite, with lower amounts of tremolite, magnesio-arfvedsonite, magnesio-riebeckite, and edenite/ferro-edenite. Depending on the valence state of iron, some minerals may also be classified as actinolite.

OA Other amphibole-type asbestos fibers. Structures having an amphibole SAED pattern and an elemental composition that is not similar to fiber types from the Libby mine. Examples include crocidolite, amosite, and anthophyllite. There is presently no evidence that these fibers are associated with the Libby mine.

[2] Copies of all Libby laboratory modifications are maintained on the Libby Lab eRoom.

CH Chrysotile fibers. Structures having a serpentine SAED pattern and an elemental composition characteristic of chrysotile. There is presently no evidence that these fibers are associated with the Libby mine. *For the purposes of this investigation, recording of chysotile structures was not required.*

NAM Non-asbestos material. These may include non-asbestos mineral fibers such as gypsum, glass, or clay, and may also include various types of organic and synthetic fibers derived from carpets, hair, etc. *Recording of NAM structures was not required.*

Because of the high number of grid openings needed to achieve the target analytical sensitivity, ABS samples were examined using counting protocols for recording phase contrast microscopy-equivalent (PCME) structures only (per ISO 10312 Annex E). That is, filters were examined at a magnification of 5,000x, and all amphibole structures (including not only LA but OA types as well) that had appropriate SAED patterns and energy dispersive x-ray analysis (EDXA) spectra, and with a length > 5 µm, width ≥ 0.25 µm, and aspect ratio (length:width) ≥ 3:1 were recorded on the Libby-specific TEM laboratory bench sheets and EDD spreadsheets.

3.1.3 Stopping Rules

The TEM stopping rules for all ABS air field samples were as follows:

- Examine a minimum of two grid openings from each of two grids.
- Continue examining grid openings until one of the following was achieved:
    - The target analytical sensitivity was achieved (0.00022 cc^{-1} for Scenarios 1-4 and 0.00175 cc^{-1} for Scenario 5)[3].
    - 25 PCME LA structures were observed.
    - A total filter area of 20 square millimeters (mm^2) was examined (approximately 2,000 grid openings).

For lot blanks and field blanks, the TEM analysis included an examination of an area of 1.0 mm^2 (approximately 100 grid openings).

3.1.4 Calculation of Air Concentration

The concentration of PCME LA in air is given by:

$$C_{air} = N \cdot S$$

[3] The target analytical sensitivity changed from 0.00011 cc^{-1} to 0.00022 cc^{-1} for Scenarios 1-4 and from 0.00088 cc^{-1} to 0.00175 cc^{-1} for Scenario 5 over the course of this study because the underlying reference concentration changed; see LFO-000160 and LFO-000162 for details.

where:

C_{air} = Air concentration, expressed as structures per cubic centimeter of air (s/cc)
N = Number of PCME LA structures observed
S = Analytical sensitivity (cc^{-1})

For air, the analytical sensitivity is calculated as:

$$S = EFA / (GOx \cdot Ago \cdot V \cdot 1000 \cdot F)$$

where:

S = Analytical sensitivity (cc^{-1})
EFA = Effective area of the filter (mm^2)
GOx = Number of grid openings examined
Ago = Area of a grid opening (mm^2)
V = Volume of air passed through the filter (L)
1000 = Conversion factor (cc/L)
F = Fraction of primary filter deposited on secondary filter (indirect preparation only)

Note that air samples with a count of zero (and hence a concentration of zero) are reported as zero. When computing the best estimate of the mean, samples with a count of zero are evaluated as zero, not at ½ the analytical sensitivity (EPA 2008). This approach yields an unbiased estimate of the true mean that does not depend on the analytical sensitivity of the samples included in the data set.

3.2 LA in Soil

3.2.1 Sample Preparation

All soil samples collected for asbestos analysis were transmitted to the Sample Preparation Facility (SPF) located in Troy, Montana for preparation prior to analysis. Samples were prepared in accordance with Libby-specific SOP ISSI-LIBBY-01. In brief, the sample was dried and then split into three approximately equal portions: 1) an archive aliquot; 2) a polarized light microscopy (PLM) aliquot; 3) a fluidized bed asbestos segregator (FBAS) aliquot. The archive aliquot was placed into archive at the Troy SPF. The PLM aliquot was sieved into coarse (> ¼ inch) and fine fractions. The fine fraction was ground to reduce particles to a diameter of 250 µm or less and this fine-ground portion was split into four equal aliquots. The FBAS aliquot was archived for possible future analysis.

3.2.2 PLM Analysis Method

Each PLM aliquot was analyzed for LA in accordance with the Libby-specific SOPs for PLM analysis. The coarse fraction (if any) was examined using stereomicroscopy, and any particles of asbestos were removed and weighed in accordance with SOP SRC-LIBBY-01, referred to as PLM-Grav. One of the fine ground fraction aliquots was analyzed by PLM using the visual area estimation method in accordance with SOP SRC-LIBBY-03, referred to as "PLM-VE". The remaining fine ground aliquots were archived at the Troy SPF.

PLM-VE is a semi-quantitative method that utilizes Libby-specific LA reference materials to allow assignment of fine ground samples into one of four "bins", as follows:

- Bin A (ND): non-detect
- Bin B1 (Trace): detected at levels lower than the 0.2% LA reference material
- Bin B2 (< 1%): detected at levels lower than the 1% LA reference material but greater than or equal the 0.2% LA reference material
- Bin C (≥ 1%): LA detected at levels greater than or equal to the 1% LA reference material, a quantitative estimate of the concentration is reported

Note: None of the soil field samples collected during the 2011 ABS investigations had a coarse fraction; therefore, this report focuses on the PLM-VE results for the fine ground fraction only.

4 SCENARIO 1: COMPARISON OF ABS SCRIPTS

4.1 Study Design

In previous outdoor ABS investigations, two different residential yard ABS scripts have been utilized. In the 2007/2008 outdoor residential yard investigation (EPA 2010a), ABS was conducted within a subarea of the yard that met the specified selection criteria and sampling duration was usually[4] about 2 hours per disturbance scenario (i.e., two hours raking, two hours mowing, and two hours digging). Often, this resulted in the subarea being mowed/raked multiple times over the course of the sampling activity duration. As a result, any existing grass was typically worn and, by the end of the sampling period, bare patches of soil were often observed. This may have resulted in elevated asbestos release during sampling. For the purposes of this report, the 2007/2008 ABS script is referred to as the "high intensity" script.

In the 2010 outdoor residential yard investigation (EPA 2014a), ABS was conducted on a yard-wide basis and sampling duration was about 20 minutes per disturbance scenario (i.e., 20 minutes raking, 20 minutes mowing, and 20 minutes digging; 60 minutes total), thus reducing both the total time and the amount of localized stress in one area. For the purposes of this report, the 2010 ABS script is referred to as the "low intensity" script. The type of residential ABS script used at a property ("high intensity" vs. "low intensity") has the potential to influence levels of LA measured in outdoor ABS air. Thus, the purpose of Scenario 1 was to collect outdoor ABS air data to provide information on differences in measured LA concentrations as a function of the ABS script.

Ten residential properties were selected for evaluation in Scenario 1. All of the selected properties were evaluated as part of the 2007/2008 residential outdoor ABS investigation (EPA 2010a). A total of three sampling events were conducted at each property in the summer of 2011, with events spaced approximately two weeks apart. Event 1 occurred in mid-July 2011, Event 2 occurred in early August 2011, and Event 3 occurred in mid-August 2011. During each event, ABS activities were performed utilizing the same "high intensity" and "low intensity" ABS scripts as used in 2007/2008 and 2010, respectively.

During each sampling event, three "high intensity" ABS air samples were collected for each property, one for each type of soil disturbance scenario (i.e., one sample for raking, one sample for digging, and one sample for mowing). The digging scenario was representative of a child digging and playing in the dirt (i.e., digging in the soil with a hand shovel and dumping buckets of soil back into the resulting hole). Each "high intensity" ABS air sample had a sampling duration of 2 hours.

[4] For a subset (23%) of the outdoor ABS samples collected during in the summer 2007 sampling event, ABS durations were less than two hours. For 8% of these samples, the ABS duration was between one and two hours per activity; for 15% of these samples the ABS duration was less than one hour per activity (EPA 2010).

During each sampling event, a single "low intensity" ABS air sample was collected at each property, representing a composite across all three soil disturbance scenarios (mowing, raking, and digging). The digging scenario was representative of an adult performing sprinkler maintenance activities (i.e., digging in the soil with a long shovel and a trowel). Each disturbance scenario was performed for 20 minutes (i.e., the ABS air sample had a total sampling duration of 60 minutes).

During each sampling event, two soil samples were collected. One surficial 30-point composite soil sample was collected to be representative of the entire ABS area. The sampling points within the 30-point composite included the two sub-locations selected for digging as part of the "low intensity" ABS script. In addition, one 2-point composite sample was collected to represent the two sub-locations selected for digging as part of the "high intensity" ABS script.

4.2 Results and Interpretation

Table 4-1 summarizes the measured ABS PCME LA air concentrations, LA soil concentrations, soil VV ranking, and ABS area conditions for each property for each Scenario 1 sampling event. Detailed analytical results are provided in the project database (see **Appendix C**).

As shown, in order to limit analytic costs, the EPA requested that only ABS air samples from the first two sampling events be analyzed. ABS air samples from the third sampling event remain in archive at the Troy SPF.

4.2.1 Comparison of ABS Air Concentrations by ABS Script

Figure 4-1 presents a comparison of the mean ABS air concentration from samples collected during the "high intensity" ABS script to the measured ABS air concentration in the sample collected during the "low intensity" ABS script at each property for each sampling event (Panel A) and across sampling events (Panel B).

These results show that there is a tendency for ABS air samples collected using a "high intensity" ABS script to have higher PCME LA air concentrations than samples collected using a "low intensity" ABS script. In general, "high intensity" ABS air concentrations tend to be higher by a factor of about 10. Because historical ABS data have been collected using both types of script, in the OU4 human health risk assessment, the EPA risk assessors will need to decide how ABS results from each script type will be utilized in estimating potential residential exposures and risks from yard soil disturbances.

4.2.2 *Comparison of ABS Air Concentrations by Year*

Because properties selected for evaluation in the 2011 ABS investigation were also evaluated in the 2007/2008 ABS investigation, it is also possible to evaluate the potential differences in measured ABS air concentrations at a given property as a function of sampling year.

Figure 4-2 presents a comparison for each property of the measured PCME LA air concentration for ABS samples collected during the summer of 2007 to the mean PCME LA air concentration for "high intensity" ABS samples collected in the summer of 2011. In this figure, the summer 2007 ABS air samples that had a sampling duration less than 30 minutes are circled.

These results show that ABS air concentrations measured in the summer of 2007 were higher than those measured in the summer of 2011 for nearly all ABS samples regardless of the scenario (raking/mowing/digging). Even when the sampling duration in 2007 was less than that in 2011, the measured air concentrations in 2007 were higher than 2011. In general, the difference in concentration was usually within a factor of 10, but in some cases, measured ABS air concentrations in 2007 were more than 100 times higher than those measured in 2011. Because the same property was evaluated in both years using the same ABS script, the most likely explanation for these differences is that they demonstrate the inherent variability in ABS air due to temporal changes in meteorological and environmental conditions.

Figure 4-3 presents annual cumulative precipitation[5] (Panel A) and maximum daily temperature (Panel B) graphs for Libby for 2007 and 2011. Based on these data, the amount of precipitation in 2007 was much lower than in 2011. In addition, the maximum daily temperatures during the ABS time period (shaded in blue) in 2007 were higher than in 2011. Thus, it is likely that soil conditions were drier in 2007, which would tend to increase the amount of asbestos released during soil disturbance activities.

These results support the conclusion that temporal variability is an important factor in determining asbestos exposures from soil for a property, perhaps even more so than the type of ABS script utilized (see Section 4.2.1). As a consequence, estimates of long-term exposures based on measured ABS results should encompass multiple years of evaluation to ensure that a range of meteorological and environmental conditions are represented.

4.2.3 *Relation of ABS Air Concentrations to PLM Soil Concentration*

One of the potential uses of the data generated during the outdoor ABS investigation is to determine if the concentration of LA observed in outdoor ABS air can be correlated with (and predicted by) the concentration of LA in the soil being disturbed. Thus, the outdoor ABS air

[5] For 2011, precipitation results are shown for both the Libby station (LBBM8) and the mine station (ZONM8). This is because of a suspected issue with the reported data for Libby station from March through May.

results from this investigation were grouped based on the measured soil levels to determine if air concentrations differed by soil level.

Note that the evaluation of the relationship between soil and "high intensity" ABS air differs for the digging activity relative to the raking and mowing activities. This is because the digging activity occurred only in two discrete sub-locations of the ABS area, so the area-wide 30-point soil composite PLM-VE results may not accurately reflect the conditions at the digging locations. Thus, PLM-VE results for the 2-point soil composite (specific to the digging locations) are used to characterize the soil levels associated with the digging ABS air concentrations.

Figure 4-4 presents a scatter plot of the measured PCME LA ABS air concentrations stratified by the reported soil PLM-VE results for LA and ABS script type. In this figure, PLM-VE results are grouped into two categories – non-detect (Bin A) and detect[6] (not Bin A). As shown, although there was considerable variability within each soil condition category, for both ABS scripts, mean ABS air concentrations were higher for locations where LA was detected in soil than locations that were non-detect. Mean ABS air concentrations for soils with detected LA tended to be about 60-70 times higher than non-detect soils for both ABS scripts.

Figure 4-5 presents a similar scatter plot, except that measured PCME LA ABS air concentrations are stratified by the VV status. In this figure, VV+ indicates where one or more sampling points contained visible levels of vermiculite and VV– where no VV was noted. As shown, the mean ABS air concentration for locations with VV+ was about 10 times higher than for VV– locations, but this was only true under the "high intensity" ABS script. There was no difference in the mean ABS air concentrations based on the VV status under the "low intensity" ABS script. However, inspection of the underlying data show that the mean concentration for the VV– dataset may be influenced by a single high value and measured air concentrations for VV– locations generally tended to be lower than VV+ locations.

These results indicate that there is a relationship between LA concentrations in outdoor ABS air and the level of LA in soil, although the strength of the trend varied somewhat between different metrics for characterizing the level of soil contamination. Based on a comparison of the mean ABS air concentrations, results by PLM-VE tended to be a better predictor of ABS air concentrations than VV inspections.

4.2.4 Relative Sensitivity of PLM-VE vs. VV Inspection

As discussed above, for every soil sample collected, there are two metrics for reporting LA levels, PLM-VE results (as reported by the analytical laboratory) and VV information (as reported by the field teams). In the *2007/2008 ABS Data Summary Report* (EPA 2010a), a

[6] Because so few detected soils were ranked as Bin B2 (three 2-point digging soil samples, three 30-point area-wide soil samples) or Bin C (two 2-point digging soil samples), all detected soils were grouped, rather than trying to stratify by PLM-VE bin.

comparison of the relative sensitivities of these two metrics suggested that VV inspection may be a somewhat more sensitive method for detecting LA in soil than PLM-VE.

Table 4-2 (Panel A) presents a comparison of PLM-VE results to VV inspection results for all soil samples collected as part of this 2011 investigation (including Scenarios 2-5). In this table, results that are ranked as concordant are shaded in grey. For comparison purposes, Panel B of this table presents a similar comparison showing the PLM-VE and VV inspection results from the 2007/2008 ABS investigation. As shown, the overall concordance between PLM-VE and VV was about 72% for the 2011 investigation, which is similar to what was observed the 2007/2008 investigation (66%). However, the conclusion that VV is a more sensitive metric than PLM-VE does not appear to be supported by the 2011 results. In 2007/2008, of the 152 samples that were ranked as VV+, only 50 samples (33%) were reported as detect by PLM-VE (i.e., not Bin A); but in 2011, of the 31 samples that were ranked as VV+, 22 samples (71%) were reported as detect by PLM-VE.

In reviewing the PLM-VE results, it was noted that a different analytical laboratory performed the soil analyses in 2011 (ESAT Region 8 laboratory) than in 2007/2008 (Reservoirs Environmental [RESI] laboratory). Inter-laboratory evaluations of the PLM laboratories indicate that the ESAT Region 8 laboratory tends to detect lower levels of LA relative to the other PLM laboratories (Shaw Environmental & Infrastructure Group [Shaw E&I] 2012a-g). As noted above, based on the results of the 2011 investigation, PLM-VE results *as reported by ESAT Region 8 laboratory* tend to be a good predictor of ABS air concentrations.

The ESAT Region 8 laboratory recently completed a PLM-VE re-analysis of all non-detect soils from the 2007/2008 ABS investigation. Based on this re-analysis effort, it was determined that about 28% of all ABS soils originally classified as non-detect (Bin A) by RESI would have been classified as trace (Bin B1) by ESAT Region 8 (CDM Smith 2012b, 2013). In addition, when outdoor ABS air results from the 2007/2008 ABS investigation were re-grouped based on the PLM-VE results reported by ESAT Region 8, the results showed that PLM-VE results *as reported by ESAT Region 8 laboratory* tend to be a good predictor of outdoor ABS air concentrations (CDM Smith 2013a). Thus, the conclusion reached in the *2007/2008 ABS Data Summary Report* (EPA 2010a) that VV is a more sensitive metric than PLM-VE is dependent upon which analytical laboratory is performing the PLM-VE analysis.

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5 SCENARIO 2: REPEAT OF 2010 ABS INVESTIGATION

5.1 Study Design

Environmental conditions (e.g., soil moisture, ground cover condition, etc.) are expected to vary temporally and have the potential to influence asbestos releasability from soil. Thus, the purpose of this sampling scenario was to collect outdoor ABS air data to provide information on differences in measured ABS air concentrations at a property as a function of sampling year.

All of the properties selected were evaluation in Scenario 2 of the 2011 investigation were previously evaluated in 2010 as part of the ABS residential yard ABS investigation (EPA 2010b). In the 2010 investigation, properties were classified into each of four different yard categories, depending upon the outdoor soil removal status and soil conditions (at the time of the 2010 investigation):

- Category 1 - no soil removal required, with PLM-VE Bin B1 in yard
- Category 2 - soil removal complete; no VV
- Category 3 - soil removal complete; VV present
- Category 4 - soil removal still required, with PLM-VE Bin B2 or Bin C in yard

These four categories were selected to be representative of the range of soil conditions that may be present in yards at residential properties in Libby based on the current soil removal triggers (EPA 2003).

A total of ten residential properties were selected for evaluation in 2011 – three from Category 1, two from Category 2, two from Category 3, and four from Category 4. A total of three sampling events were conducted at each property in the summer of 2011. During each event, ABS activities were conducted using an ABS script that was the same as that used in the 2010 residential yard ABS sampling efforts (EPA 2010b). In brief, a single ABS air sample was collected from each property, representing a composite of ABS soil disturbance activities (i.e., raking, digging, and mowing). Each disturbance activity was performed for 20 minutes (i.e., a total sampling duration of one hour for each composite ABS air sample).

During each event, one surficial 30-point composite soil sample was collected to be representative of the entire yard. The sampling points within the 30-point composite included the two sub-locations selected for digging.

5.2 Results and Interpretation

Table 5-1 summarizes the measured ABS PCME LA air concentrations, LA soil concentrations, soil VV ranking, and ABS area conditions for each property for each Scenario 2 sampling event. Detailed analytical results are provided in the project database (see **Appendix C**).

5.2.1 Comparison of 2010 and 2011 ABS Results

Table 5-2 presents a comparison of the ABS PCME LA air concentrations from the 2010 investigation to the 2011 investigation. **Figure 5-1** depicts these results graphically. The comparison of these two datasets is hampered by the fact that, with the exception of properties in Category 4, no asbestos structures were observed in any of the 2010 ABS air samples and the target analytical sensitivity (TAS) in 2010 was not adequate to support making meaningful comparisons to results from 2011. The 2010 ABS air samples for Category 4 properties were recently re-evaluated as part of a supplemental TEM analysis effort to improve the achieved analytical sensitivity for these samples (i.e., the TAS was lowered from 0.002 cc^{-1} to 0.0005 cc^{-1}) (CDM Smith 2012c,d). Due to the high level of effort associated with the supplemental analysis (i.e., on average, about 250 additional grid openings per ABS air samples would need to be examined to achieve the TAS), Category 4 ABS air samples were preferentially selected for supplemental TEM analysis.

For Category 4 properties, although concentrations for a given property differ by about one order of magnitude from each other depending the sampling year (2010 versus 2011), this is expected given the inherent variability associated with outdoor ABS investigations. In general, the mean ABS PCME LA air concentrations are similar between the two years. In both years, Property #11 had the highest ABS air concentrations, Property #10 had the lowest ABS air concentrations, and Properties #8 and #9 had detected LA air concentrations that were generally similar (see **Figure 5-1**).

Figure 5-2 presents annual cumulative precipitation[7] (Panel A) and maximum daily temperature (Panel B) graphs for Libby for 2010 and 2011. Based on these data, the amount of precipitation in 2010 was generally similar to 2011. In addition, the maximum daily temperatures during the ABS time period (shaded in blue) were also similar. Thus, it is likely that soil conditions in 2010 were similar to those in 2011 (although vegetative conditions may have differed), which would support the conclusion that the differences in the amount of asbestos released during soil disturbance activities reflect the inherent variability that is associated with outdoor ABS.

[7] For 2011, precipitation results are shown for both the Libby station (LBBM8) and the mine station (ZONM8). This is because of a suspected issue with the reported data for Libby station from March through May.

5.2.2 *Relation of ABS Air Concentrations to PLM Soil Concentration*

As noted above, one of the potential uses of the data generated during the outdoor ABS investigation is to determine if the concentration of LA observed in outdoor ABS air can be correlated with (and predicted by) the concentration of LA in the soil being disturbed.

Figure 5-3 presents a scatter plot of the measured PCME LA ABS air concentrations stratified by the reported soil PLM-VE results for LA. In this figure, PLM-VE results are grouped into two categories – non-detect (Bin A) and detect[8] (not Bin A). As shown, there was considerable variability within each soil condition category, but ABS air concentrations tended to be higher for locations where LA was detected in soil than locations that were non-detect. Mean ABS air concentrations for soils with detected LA tended to be about 30 times higher than non-detect soils. These results support the conclusion that there is a relationship between LA concentrations in outdoor ABS air and the level of LA in soil reported by PLM-VE. [Note: All PLM-VE analyses were performed by ESAT Region 8 laboratory.]

5.2.3 *Comparison of ABS Air Concentrations by Property Soil Removal Status*

As noted above, in this investigation, properties selected for evaluation were classified into four categories based on outdoor soil removal status (based on soil samples collected in the yard at the time of the 2010 investigation. **Figure 5-4** presents a comparison of mean PCME LA concentrations in ABS air samples for each property category. As shown, the mean concentrations for Categories 1, 2, and 3 (where removal has already been performed or not deemed to be necessary) were generally similar, whereas mean concentrations for Category 4 (where removal has yet to be performed) tended to be about 30 times higher than the other three categories. These results support the conclusion that the current soil removal triggers are effective in reducing potential exposures due to LA in outdoor soil. These results also support the conclusion that, on average, there is little difference in ABS air concentrations between properties where a removal has already been performed and properties where a removal is not deemed to be necessary, or between properties with and without VV in the yard after a removal has been performed. However, as noted in Section 4, the intensity of the soil disturbance activity and temporal variability are both important factors in determining asbestos exposures from soil for a property. Thus, interpretation of these results is limited because they only provide information for conditions achieved during a single summer under one type of ABS disturbance scenario (low intensity).

[8] Because so few detected soils were ranked as Bin B2 (N = 2 samples), all detected soils were grouped, rather than trying to stratify by PLM-VE bin.

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6 SCENARIO 3: MOWING BEFORE & AFTER IRRIGATION

6.1 Study Design

The EPA has provided a recommendation to the Libby community that lawns should be irrigated or watered before mowing to reduce potential releases of LA into the air during mowing. Thus, the purpose of this sampling scenario was to collect outdoor ABS air data to evaluate the effectiveness of lawn irrigation in limiting asbestos releases during mowing.

Three residential properties were selected for evaluation. These properties were selected because measured ABS air concentrations during the mowing activity conducted as part of the 2007/2008 ABS investigation (EPA 2010a) reported detected levels of total LA. Two types of ABS air samples were collected from each property. One sample was collected under "without irrigation" conditions (i.e., lawn had not been irrigated for at least 36 hours prior to ABS) and the other sample was collected immediately following irrigation ("with irrigation").

A total of six sampling events were performed at each property, three events with irrigation and three events without irrigation. One event was conducted every two weeks in the summer of 2011, with the type of event performed (with or without irrigation) alternating between events. Each mowing event was a "one-pass"[9] mowing of the entire yard (there was no specified sampling duration).

During each event, one surficial 30-point composite soil sample was collected to be representative of the entire yard.

6.2 Results and Interpretation

Table 6-1 summarizes the measured ABS PCME LA air concentrations, LA soil concentrations, soil VV ranking, and ABS area conditions for each property for each Scenario 3 sampling event. Detailed analytical results are provided in the project database (see **Appendix C**). Mean ABS PCME LA air concentrations for each property for each irrigation condition are presented in **Figure 6-1**. As shown, irrigation of the lawn prior to mowing did not appear to reduce the concentration of PCME LA asbestos in air during mowing activities. Air concentrations of LA did not appear to correlate with the VWC of the soil, nor did they appear to differ as a function of either vegetative extent or condition (figures not shown). However, interpretation of these results is confounded by several limitations in the study design.

First, although the properties were selected because total LA was detected previously in the 2007/2008 ABS air samples, the levels of PCME LA measured for the three selected properties tended to be on the lower end of the range of detected concentrations. In addition, LA concentrations in soil for the three selected properties also tended to be low, with reported

[9] The entire yard was mowed once, without re-mowing areas that had already been mowed.

concentrations tending to be primarily non-detect (Bin A) and no or low levels of VV noted. Thus, being able to detect a meaningful difference between the with/without irrigation sampling events would have required a much lower analytical sensitivity than was achieved.

Second, because the with/without irrigation events were separated in time, it appears that temporal variability in environmental soil conditions may have played a larger role than irrigation in affecting soil moisture. For example, at property AD-001867, Event 1 (without irrigation) was conducted on July 14th and the measured VWC was 13.2%, whereas Event 2 (with irrigation) was conducted two weeks later on July 28th and the measured VWC post-irrigation was 8.8% (see **Table 6-1**). Thus, even after irrigation, the measured VWC was higher during the "without irrigation" event than the "with irrigation".

Finally, as noted in **Table 6-1**, the lawn condition at all three properties was ranked as good or lush and the vegetation extent was usually greater than 75%. It is expected that use of irrigation to suppress airborne dust during mowing is likely to be most important for lawns that are in poor condition and where vegetation extent is sparse.

If this study is repeated in the future, properties should be selected to represent locations with high PCME LA concentrations in air during mowing and with elevated soil concentrations (e.g., PLM-VE Bin B2/C). In addition, to limit confounding due to temporal variability in environmental conditions, the amount of time between sampling events should be limited (e.g., performing the "without irrigation" event in the morning and the "with irrigation" event in the afternoon on the same day).

7 SCENARIO 4: CURB-TO-CURB PROPERTIES

7.1 Study Design

Previous outdoor ABS efforts did not include properties in which a full yard removal (i.e., a "curb-to-curb" soil removal) had been conducted. Thus, the purpose of this sampling scenario was to collect outdoor ABS air data to determine if residual risks at post-removal "curb-to-curb" properties are within acceptable limits.

Eleven[10] residential properties were selected for evaluation. These properties were selected because they had undergone a "curb-to-curb" yard removal between 2008 and 2010. A total of three sampling events were conducted at each property in the summer of 2011. During each event, ABS activities were conducted using an ABS script that was similar to the 2010 residential yard ABS script, except that the sampling duration of each scenario was extended to be more representative of expected residential conditions. In brief, for each event, a single ABS air sample was collected from each property, representing a composite of ABS soil disturbance activities (i.e., raking, digging, and mowing). The mowing portion of the composite represented a one-pass mowing of the entire yard (there was no specified sampling duration). The raking portion of the composite represented a one-pass raking of the entire yard (there was no specified sampling duration). The digging portion of the composite represented digging a hole at each of 2-6 locations, simulating sprinkler maintenance activities (i.e., digging with a long shovel and trowel).

During each event, one surficial 30-point composite soil sample was collected to be representative of the entire yard. The sampling points within the 30-point composite included the sub-locations selected for digging.

7.2 Results and Interpretation

Table 7-1 summarizes the measured ABS PCME LA air concentrations, LA soil concentrations, soil VV ranking, and ABS area conditions for each property for each Scenario 4 sampling event. Detailed analytical results are provided in the project database (see **Appendix C**). As shown, soil concentrations by PLM-VE were reported as non-detect (Bin A) for all but one soil sample and VV was rarely observed (low levels were observed in two samples). However, LA was detected in air in one or more ABS air samples for six properties. In general, PCME LA concentrations in air tended to be fairly low for most samples, with concentrations usually less than about 0.001 PCME LA s/cc. Only one property consistently had detected LA concentrations in air for all three sampling events. Most notable was that concentrations in two ABS air samples from two different properties exceeded 0.01 PCME LA s/cc. For these two

[10] The original study design identified a target of ten properties. However, one of the original ten properties selected dropped out of the study after the first sampling event. Thus, one additional property was added to achieve the study objectives.

properties, ABS results tended to be highly variable between sampling events, ranging from non-detect (<0.00022 PCME LA s/cc) to higher than 0.01 PCME LA s/cc depending upon the sampling event.

The fact that LA structures were detected in ABS air samples from curb-to-curb properties is somewhat unexpected because the soils at these properties are representative of topsoil fill material. Topsoil fill is soil material that is brought in from borrow pits to replace materials that have been removed as part of a soil removal. Because these fill materials are not exposed until excavation, it is believed that they are not impacted by mining-related releases. Assuming there was no re-contamination of the property following the soil removal action, the curb-to-curb ABS results suggest that soils used as topsoil fill may contain low levels of LA (below that which can be reliably detected by PLM-VE or observed via VV inspection in the field) that are not mining-related. Indeed, other investigations conducted at the Site show that LA structures have been consistently detected in "background" soils within the Kootenai Valley that are not thought to be affected by anthropogenic releases from vermiculite mining and processing activities (EPA 2014b).

Meeker *et al.* (2003) observed that most LA structures from the Vermiculite Mountain ore body contain detectable levels of both sodium and potassium in the EDS. A review of the EDS spectra for the LA structures observed in the ABS air samples collected during the curb-to-curb property evaluation (see **Table 7-2**) shows some LA structures where sodium and potassium peaks were not present in the EDS. In particular, for one of the ABS air samples with the highest PCME LA concentrations (the Event 1 ABS air sample from property AD-000414), 23 of the 25 LA structures observed did not have sodium or potassium peaks in the EDS spectra and the analyst indicated the structures were characteristic of tremolite asbestos. These results support the conclusion that not all of the LA structures noted in the curb-to-curb ABS air samples are likely derived from the Vermiculite Mountain ore body. The *Background Soil Summary Report* (EPA 2014b) provides additional information on background levels of LA in soil in the Kootenai Valley.

8 SCENARIO 5: LIMITED-USE AREAS

8.1 Study Design

Previous outdoor ABS efforts collected at residential properties have focused on common-use areas (CUAs), such as the yard, and specific-use areas (SUAs), such as driveways, gardens, and flowerbeds. However, no outdoor ABS data had collected from LUAs. LUAs include portions of a property that are accessed, utilized, and maintained on a limited basis (e.g., pastures, maintained/mowed fields). Thus, the purpose of this sampling scenario was to collect outdoor ABS air data from LUAs at a property.

Ten ABS areas were selected for evaluation from seven residential properties (for three properties, two different LUAs were evaluated). Five ABS areas were selected from each of the following categories (based on previously collected soil samples for the LUA):

- Category 1: PLM-VE Bin A (non-detect) and visible vermiculite is not present (Vis-); LUA removal status was not a requirement.

- Category 2: PLM-VE Bin B1 (< 0.2% LA) or greater reported and/or visible vermiculite is present (Vis+); LUA removal status was not a requirement.

A total of three sampling events were performed at each ABS area in the late summer of 2011. Two actors rode ATVs for a duration of one hour. Riders engaged in activities for 30 minutes that were representative of riding in a single-file line (i.e., one rider leading, one rider following), with the leader/follower switching positions after 15 minutes. Riders rode separately for the remaining 30 minutes and covered as much of the LUA as possible.

During each event, one surficial 30-point composite soil sample was collected to be representative of the entire LUA.

8.2 Results and Interpretation

Table 8-1 summarizes the measured ABS PCME LA air concentrations, LA soil concentrations, soil VV ranking, and ABS area conditions for each property for each Scenario 5 sampling event. Detailed analytical results are provided in the project database (see **Appendix C**).

Figure 8-1 presents a scatter plot of the measured PCME LA ABS air concentrations stratified by the reported soil PLM-VE results for LA. In this figure, PLM-VE results are grouped into two categories – non-detect (Bin A) and detect (Bin B1). As shown, although there was some variability within each soil condition category, ABS air concentrations tended to be about the same for locations where LA was detected in soil and locations that were non-detect. Visible vermiculite was not observed at any of the locations. These results demonstrate that there is

little difference between LA concentrations in outdoor ABS air in LUAs where soils are ranked as Bin A or Bin B1 and no VV is observed. [Note: All PLM-VE analyses were performed by ESAT Region 8 laboratory.]

9 DATA QUALITY ASSESSMENT

Data quality assessment (DQA) is the process of reviewing existing data to establish the quality of the data and to determine how any data quality limitations may influence data interpretation (EPA 2006).

9.1 Field and Laboratory Oversight

9.1.1 Field

Field surveillances consist of periodic observations made to evaluate adherence to investigation-specific governing documents. Field audits are broader in scope than field surveillances and are evaluations conducted by qualified technical or quality assurance (QA) staff that are independent of the activities audited.

A field audit was conducted for the 2011 Residential ABS program on July 27, 2011 (CDM Smith 2012e). This audit reviewed ABS activities for Scenario 1 (raking/mowing/digging in yards), including air and soil sample collection, global positioning system (GPS) point collection, field QC sample collection, equipment calibration and decontamination procedures, and personal protective equipment. In addition, a review of field documentation, including field logbook entries, FSDS forms, property background forms, and ABS area sketches was performed. The following overall conclusions were noted:

- All teams had field access to the latest version of the governing SAP (CDM Smith 2011).
- No deficiencies were noted regarding the collection of the ABS personal air samples or soil samples; sampling requirements specified in the SAP were met by field personnel for ABS air and soil sampling activities.
- No deficiencies were noted regarding general field processes; the general process requirements specified in the SAP were met by field personnel.
- The field QC sample types and collection frequencies specified in the SAP were met by field personnel.
- Field documentation reviewed was remarkably consistent, legible, and had few errors or omissions; field documentation requirements specified in the SAP were met by field personnel.

In summary, no significant deficiencies were observed the day of the audit. The auditor noted that the sampling team members were conscientious and understood the need to collect high-quality air and soil samples as part of the ABS efforts (CDM Smith 2011).

Although no formal audit was conducted as part of Scenario 5 (LUA), the field team leader (FTL) was present and observed sample collection activities and ensured that governing documents were implemented appropriately.

9.1.2 Laboratory

Laboratory audits are conducted to evaluate laboratory personnel to ensure that samples are handled and analyzed in accordance with the program-specific documents and analytical method requirements (or approved Libby laboratory modification forms) to make certain that analytical results reported are correct and consistent. All aspects of sample handling, preparation, and analysis are evaluated. If any issues are identified, laboratory personnel are notified and retrained as appropriate.

A series of laboratory audits was performed in May-September of 2012 to evaluate all of the Libby laboratories. Detailed audit findings for each laboratory are documented in separate laboratory-specific audit reports (Shaw E&I 2012a-g). No critical deficiencies were noted during the 2012 laboratory audits that would be expected to impact data quality for TEM analyses. However, there were some differences between the laboratories that were noted for PLM.

In particular, while there were slight differences in how the PLM analysts performed the steps of the analysis procedure, it was noted that the ESAT Region 8 laboratory personnel performed a manual grinding of the soil sample using a mortar and pestle prior to analysis by PLM-VE. It is possible that this additional grinding step further reduces heterogeneity in the soil sample and may actually improve the ability of the PLM-VE analysis to detect LA if it were present. It was also noted that ESAT Region 8 laboratory employed a much more vigorous manual agitation of the sample prior to stereomicroscopy examination than the other laboratories. Sample agitation is used to cause asbestos structures to "rise" to the surface of the soil particles to allow for easier observation. For the purposes of this report, since all PLM-VE analyses were performed by ESAT Region 8 laboratory, there are no anticipated negative implications on the PLM-VE analyses associated with the laboratory audit findings.

9.2 Field and Laboratory Modifications

During any large-scale sampling program, such as this ABS investigation, deviations from the original SAP and/or SOPs may occur and it may be necessary to modify procedures as originally specified to optimize sample collection. Any field or laboratory deviations or modifications from the SAP and/or SOPs are recorded on a Libby-specific Record of Modification (ROM) form. The ROM forms are used to document all permanent and temporary changes to procedures contained in guidance documents governing this investigation that have the potential to impact data quality or usability. Any minor deviations (i.e., those that will not impact data quality or usability) are documented in the field logbooks. **Appendix D** provides copies of all applicable modifications associated with this investigation.

Four Libby field ROMs (LFO-000160, LFO-000161, LFO-000162 and LFO-000172) were instituted for the 2011 Residential ABS investigation. **Table 9-1** presents the field deviations summarized in each field ROM, and includes an evaluation of the potential data quality implications for each

deviation. As shown, very few of the deviations identified in these field ROMs are expected to negatively impact data quality or usability.

One temporary laboratory ROM (LB-000090) was prepared for TEM ABS air analyses conducted in support of this 2011 Residential ABS investigation. This modification was instituted to document the ABS air samples that were affected by a change in structure recording procedures for partially obscured structures (i.e., a deviation from ISO 10312, Section C.4.8) and describes the resolution for adjusting the benchsheets and structure documentation for these samples. In brief, several LA structures identified in the original TEM analysis were changed to be non-countable because the unobscured portion of the structure did not meet PCME counting rules. This modification decreased the number of countable structures for five ABS air samples; hence, the reported air concentration may be biased low for the affected air samples. However, for the affected samples, structure counts were higher than ten structures for most samples prior to the implementation of this modification, and this change usually only excluded 1-4 structures per sample. There are no instances where a sample changed from detected to non-detect as a consequence of this modification.

9.3 Data Review, Verification, and Validation

9.3.1 Data Review and Verification

The Libby Scribe project databases have a number of built-in QC checks to identify unexpected or unallowable data values during upload into the database. Any issues identified by these automatic upload checks were resolved by consultation with the field teams and/or analytical laboratory before entry of the data into the database. After entry of the data into the database, several additional data verification steps were taken to ensure the data were recorded and entered correctly.

In order to ensure that the database accurately reflects the original hard copy documentation, all data downloaded from the database were examined to identify data omissions, unexpected values, or apparent inconsistencies. In addition, because these results have been provided to the property owners, 100% of all samples and analytical results for this ABS investigation underwent a detailed verification. In brief, verification involves comparing the data for a sample in the database to information on the original hard copy FSDS form and on the original hard copy analytical bench sheets for that sample. Any omissions or apparent errors identified during the verification were submitted to the field teams and/or analytical laboratories for resolution in the database and in the hard copy documentation. **Appendix E** presents the detailed findings of the data verification effort for this ABS investigation. These findings are summarized below.

FSDS Review. Hard copy FSDS forms were reviewed for a total of 220 ABS air and 179 soil samples as part of the data verification effort in accordance with Libby-specific SOP

EPA-LIBBY-11, *FSDS Data Review and Data Entry Verification*. The critical error[11] rate based on a review of the FSDS forms was about 4% for ABS air samples and 1% for soil samples. In general, most of the issues identified were important for the purposes of sample tracking (e.g., Property ID, Location ID), but would not have influenced the quantitative analytical results reported for the sample.

TEM Review. A total of 221 TEM analyses for ABS air were reviewed as part of the data verification effort in accordance with Libby-specific SOP EPA-LIBBY-09, *TEM Data Review and Data Entry Verification*. The critical error rate based on a review of the TEM benchsheets was about 28%. In general, most of the issues identified were related to data entry errors in structure specific attributes (e.g., structure length, structure width), which have the potential to influence the number of PCME structures counted. Additionally, errors in grid opening names in the EDD were noted, which have the potential to influence the achieved analytical sensitivity. Although an incorrect grid opening name has the potential to impact the achieved analytical sensitivity and reported concentration, the magnitude of the change in the reported concentration is small (especially when the number of grid openings examined is large). For one sample, the analytical laboratory had to examine additional grid openings in order to reach the TAS. There did not appear to be any trends in analyses where critical errors were noted (i.e., critical errors were noted across nearly all analysts from all laboratories).

PLM Review. A total of 179 PLM analyses for soil were reviewed as part of the data verification effort in accordance with Libby-specific SOP EPA-LIBBY-10, *PLM Data Review and Data Entry Verification*. No discrepancies were identified.

All issues identified during the data verification effort were submitted to the field teams and/or analytical laboratories for resolution and rectification. All tables, figures, and appendices (including all hard copy documentation [**Appendix A**] and the database [**Appendix B**], and **Attachment 1**) generated for this report reflect corrected data.

9.3.2 Data Validation

Unlike data verification, where the goal is to identify and correct data reporting errors, the goal of data validation is to evaluate overall data quality and to assign data qualifiers, as appropriate, to alert data users to any potential data quality issues.

Data validation is performed by the EPA Quality Assurance Technical Support (QATS) contractor (CB&I Federal Services, LLC [CB&I]), with support from technical support staff that are familiar with investigation-specific data reporting, analytical methods, and investigation requirements. For the Libby project, data validation of TEM and PLM results is performed in

[11] A critical error is defined as an error that has the potential to impact the reported LA concentration or sample identification information.

accordance with Libby-specific validation SOPs (QATS-70-094-01, QATS-70-095-01) that were developed based on the draft *National Functional Guidelines (NFG) for Asbestos Data Review* (EPA 2011).

The EPA QATS contractor prepares an annual summary of the program-wide assessment of quality assurance/quality control (QA/QC). This annual summary provides detailed information on the validation procedures performed and provides a narrative on the quality assessment for each type of analysis (e.g., TEM, PLM), including the data qualifiers assigned and the reason(s) for these qualifiers to denote when results do not meet acceptance criteria. This annual summary details any deficiencies, required corrective actions, and makes recommendations for changes to the QA/QC program to address any data quality issues.

In 2013, the EPA QATS contractor performed a formal data validation of asbestos results for samples collected and analyzed in 2010 to 2012 across all Site OUs. A detailed summary of this data validation effort is summarized in CB&I (2013). The conclusions of this review are provided below.

A total of 2,227 field samples (5%) from 263 different laboratory jobs analyzed by five different laboratories between 2010 and 2012 were selected for validation. Samples for validation were selected randomly, to be representative across laboratory, analysis method, and media type. Very few asbestos results were qualified (less than 0.5% of all analyses reviewed) were J-qualified as a result of the validation. Two of the samples that were qualified (EX-20309 and EX-20314) were air samples collected during Scenario 1 (see Section 4) and one of the samples that was qualified (EX-20426) was an air sample collected during Scenario 4 (see Section 7). These samples were J-qualified due to the failure of the laboratory to perform and/or document daily calibration activities. No other samples utilized in this report were qualified as a consequence of the data validation.

9.4 Field Quality Control

Field-based QC samples are those samples that are collected in the field and submitted to the laboratory in parallel with the field samples. The following sections describe the field QC samples that were collected for air and soil as part of this ABS investigation.

9.4.1 Air

Two types of field QC samples were collected as part of ABS air sampling for this investigation – lot blanks and field blanks.

According to the field modification LFO-000160, 5% of all LV filters (8 samples) were to be selected *post hoc* to serve as field duplicates for ABS air samples. Because the number of grid openings that would need to be examined would be greater than 500 grid openings per sample,

to limit analytic costs, analysis of LV samples was not performed. All LV samples are in archive at the Troy SPF if future analyses are deemed necessary.

9.4.1.1 Lot Blanks

A lot blank is a randomly selected filter cassette from a manufactured lot. Lot blanks are collected to ensure air samples for asbestos analysis are collected on asbestos-free filters. Lot blank sampling is performed at a frequency of one lot blank per every 500 cassettes. Only cassette lots where no asbestos is detected in the lot blank are placed into circulation for use in air sample collection, which ensures that the air cassette filters used in this investigation were free of asbestos fibers prior to sampling activities.

9.4.1.2 Field Blanks

Field blanks are collected to evaluate potential contamination introduced during sample collection, shipping and handling, or analysis. As specified in the governing SAPs(CDM Smith 2011, 2012a), field blanks were to be collected at a rate of one per air sampling day per property, and 10% of the collected field blanks were to be analyzed each week. For Scenarios 1-4, a total of 103 field blank samples were collected for asbestos analysis by TEM under this ABS investigation, of these, 11 field blank samples were chosen for analysis by TEM (1.0 mm^2 of filter was examined for each field blank). Although the target collection frequency for field blanks was not achieved during eight out of 121 sampling events (i.e., field blanks were not collected from every property on every day when field sampling occurred), no asbestos structures were reported in any of the analyzed field blanks; thus, there are no negative implications as a result of this oversight.

For Scenario 5, as documented in LFO-000172 (see Section 9.2), a field blank was collected prior to each of three events performed in the same ABS area on the same day, resulting in a collection frequency higher than required. A total of 29 field blanks were collected for asbestos analysis by TEM under this ABS investigation; of these, three were chosen for analysis by TEM. No asbestos structures were reported in any of the analyzed field blanks.

These results demonstrate that asbestos was not introduced into the air samples as a consequence of sample collection, shipping and handling, or analysis.

9.4.2 Soil

Field duplicate samples were collected as part of the soil sampling for this investigation. Field duplicates for soil were collected from the same area as the parent sample but from different individual sampling points. These samples were collected independent of the original field sample with separate sampling equipment and submitted for analysis along with the collected

field samples. The field duplicate contains the same number of subsamples as the parent sample (i.e., the field duplicate sample is also a 30-point composite).

Soil field duplicate samples were collected at a rate of 1 field duplicate per 20 field samples (5%). A total of nine field duplicate samples were collected. Field duplicates were sent for analysis by the same method as field samples (PLM) and were blind to the laboratories (i.e., the laboratory could not distinguish between field samples and field duplicates).

Table 9-2 presents an evaluation of the soil field duplicate results. As shown, five field duplicate samples reported the same bin as the original parent sample and four field duplicate samples reported a result that was within one bin of the original parent sample (i.e., Bin A vs. Bin B1); no field duplicate samples differed by more than one bin. None of the field duplicates had a coarse fraction (i.e., no comparison of PLM-Grav results is needed).

The variability between the field duplicate and the associated parent field sample reflects the combined variation in sample heterogeneity and the variation due to measurement error. Because field duplicate samples are expected to have inherent variability that is random and may be either small or large, typically, there is no quantitative requirement for the agreement of field duplicates. Rather, results are used to determine the magnitude of this variability to evaluate data usability.

9.5 Laboratory Quality Control

Preparation and analytical laboratory QC analyses are evaluated by the EPA QATS contractor on a program-wide basis rather than on an investigation-specific basis. The rationale for this is that the number of laboratory QC samples directly related to any single investigation is too limited to draw meaningful conclusions regarding overall data quality. The program-wide QA/QC summary report covering samples collected and analyzed in 2010-2012 (CB&I 2013) contains conclusions for each analytical method and type of laboratory QC analysis. See below for a brief overview of the findings of this report for TEM and PLM analyses performed in 2010 through 2012.

- No LA structures were detected in laboratory blank analyses.
- TEM recount same and recount different analyses ranked as good to acceptable based on program-wide criteria.
- TEM repreparation analyses were all within 90% Poisson confidence interval.
- For TEM, there is generally good concordance for intra-laboratory analyses. However, for the intra-laboratory comparisons, differences in methods or procedures between analytical laboratories were noted and corrective action may be useful in achieving better agreement and reducing discrepancies due to analytical procedure differences.
- Soil preparation duplicates show that results are not greatly influenced by differences in soil preparation laboratory techniques.

- For PLM-VE, concordance rates rank as acceptable for intra-laboratory analyses. Inter-laboratory analyses suggest that there are differences in methods or procedures between analytical laboratories and corrective action may be useful in achieving better agreement and reducing uncertainties due to analytical procedure differences.

Additionally, there is one issue that has been identified based on the compilation of the preliminary TEM inter-laboratory analyses and review of TEM analyses for other investigations. Between-laboratory differences have been noted on the differentiation of LA structures from NAM structures (e.g., pyroxene) and the determination of sodium and potassium content of LA structures. Preliminary results suggest that the EMSL analytical laboratory located in Libby, Montana (EMSL27) has a narrower definition of the chemical compositions included in the LA assignment, meaning that this laboratory may record an observed structure as non-countable NAM while another TEM laboratory would rank the same structure as countable LA (TechLaw 2013). Because about 50% of all TEM analyses of ABS air samples performed for this investigation were performed by EMSL27, it is possible that reported air concentrations in this report are biased low.

9.6 Data Adequacy

A comparison of the data collected with the DQOs specified in the governing SAPs (CDM Smith 2011, 2012a) is presented below.

9.6.1 Spatial and Temporal Representativeness

Spatial

As specified in the DQOs, the spatial bounds of this investigation were to be restricted to properties located within OU4 of the Libby Asbestos Superfund Site. This OU includes most current residential and commercial properties in the Libby community. All of the samples collected as part of this investigation were collected from properties within OU4. Thus, the collected data meet the spatial objectives specified in the in the governing SAPs.

Temporal

As specified in the DQOs, the exact dates of ABS sampling were not important and selected at random, within the following constraints:

- ABS should be restricted to summer months (July-September), when conditions for asbestos release are generally favorable.
- ABS should not occur if rainfall in the past 36 hours has exceeded ¼ inch.
- ABS should not occur if there is standing water present or if the average volumetric water content (VWC) is greater than 30% *via* field probe instrumentation (this restraint did not apply to the mowing after irrigation scenario).

- For Scenario 3, mowing ABS should be performed at a specified property at 2-week intervals.

With exception of the few deviations noted in LFO-000161 (see Section 9.2), all samples were collected within the constraints specified above. Thus, it is concluded that, the collected data meet the temporal objectives specified in the in the governing SAP.

9.6.2 Sample Completeness

The completeness of the dataset is described as a ratio of the amount of data expected from the field program versus the amount of valid data received from the laboratory. For the purposes of this investigation, valid data are considered to be those that have not been rejected during the validation process and have been verified in accordance with the Libby-specific data verification SOPs. Completeness can be expressed by the following equation:

$$\text{Completeness} = \frac{\text{(total number of valid results)}}{\text{(total number of requested results)}} \times 100$$

Based on the data verification (Section 9.3.1) and data validation (Section 9.3.2) findings discussed above, the completeness of each sample set collected as part of this ABS investigation is shown in **Table 9-3**. As shown, with the exception of Scenario 1 ABS air samples, the actual number of samples collected and analyses performed met or exceeded the target for all scenarios for both media types (ABS air and soil). For Scenario 1 ABS air samples, based on a review of the results for ABS air samples collected in Events 1 and 2, the EPA determined that analysis of ABS air samples collected as part of Event 3 was not necessary to support decision-making. Thus, the completeness was only 67% for Scenario 1 ABS air, but this was determined to be sufficient and not deemed a data limitation.

9.6.3 Confirmation of TEM Analysis Stopping Rules

Specific requirements for the TEM analysis of ABS air samples were detailed in the SAPs (CDM Smith 2011, 2012a). The analysis stopping rules were summarized in Section 3.1.3 of this report. In brief, analysis continued until either the TAS (0.00022 cc^{-1} for Scenarios 1-4 and 0.00175 cc^{-1} for Scenario 5) was achieved, 25 PCME LA structures were observed, or a total filter area of 20 mm^2 was examined (approximately 2,000 grid openings).

Of the 220 ABS air samples analyzed, 178 samples (80%) achieved the TAS (or lower) and 21 samples (10%) observed 25 or more PCME LA structures. For 13 ABS air samples (6%), the analysis continued until 20 mm^2 of filter had been examined (i.e., the maximum filter area examined achieved the stopping rule). The air concentration estimates for these samples have somewhat higher uncertainty than if the samples had been analyzed until the analytical sensitivity was achieved. However, it is not expected that this leads to any bias in the data, and

because only 13 of 220 samples (6%) halted the TEM analysis based on this stopping rule, the overall impact on data quality is not expected to be significant.

For eight[12] ABS air samples, no stopping rule was achieved. For five of these samples, the laboratory was only a few LA structures short of meeting the structure count-based stopping rule (i.e., the observed number of PCME LA structures was 21-24 structures). Because of the high number of structures observed in these samples, there is likely to be little impact on uncertainty in the estimated air concentration. For three of these samples, the laboratory was only a few grid openings short of achieving the TAS. Because the achieved sensitivity was within rounding error of the target, there is likely to be little impact on uncertainty in the estimated air concentration for these samples.

9.6.4 ABS Air Filter Loading

The TEM analysis of ABS air filters examines only a portion of the total filter. For the purposes of computing air concentration for the sample, it is assumed that the filter is evenly loaded. The assessment of filter loading evenness is evaluated using a Chi-square (CHISQ) test, as described in ISO 10312 Annex F2. If a filter fails the CHISQ test for evenness, the reported result may not be representative of the true concentration in the sample, and the results should be given low confidence. An evaluation of filter loading for the ABS air samples from this investigation shows that 214 of 220 filters (97%) passed the CHISQ test (i.e., p value ≥ 0.001). According to ISO 10312, if a filter fails the CHISQ test, uneven filter loading can be addressed by performing an indirect preparation or reading additional grid openings. For the six filters that failed the CHISQ test, four of the filters had already been prepared using an indirect preparation method and the number of grid openings examined ranged from about 100 to over 1,800. Because of the low frequency of CHISQ failures, it is concluded that uneven filter loading is not of significant concern for the ABS air samples analyzed in this investigation.

9.6.4 Indirect Preparation of ABS Filters

During TEM analysis, the analytical laboratories noted that the HV filter for 99 ABS air samples[13] was overloaded with particulates (i.e., particulate loading was greater than 25%). For 31 of these ABS air samples, the corresponding LV filter was able to be prepared directly. Because the LV filter represents the same sampling duration but a lower total air sample volume, the only consequence of preparing the LV filter instead of the HV filter is that more grid openings needed to be examined to achieve the analytic requirements.

[12] One ABS air sample did not achieve the TAS in the original analysis. A subsequent supplemental analysis was performed (i.e., additional grid openings were examined) in order to achieve the TAS.
[13] For two ABS air samples, the HV sample was damaged during collection, thus the corresponding LV filter was analyzed (one was analyzed using the direct preparation method and one was analyzed using the indirect preparation method after ashing).

For 68 of these ABS air samples, the corresponding LV filter was also determined to be overloaded, thus the HV filter was analyzed using an indirect preparation method after ashing[14] in accordance with Libby-specific SOP EPA-LIBBY-08, *Indirect Preparation of Air and Dust Samples for TEM Analysis*. Most of the filters that required indirect preparation were collected during Scenario 1 under the "high intensity" ABS script or during Scenario 5 (ATV riding in LUAs), which are disturbance scenarios where dust generation was higher. For chrysotile asbestos, indirect preparation often tends to increase structure counts due to dispersion of bundles and clusters (Hwang and Wang 1983; HEI-AR 1991; Breysse 1991). For amphibole asbestos, the effects of indirect preparation are generally much smaller (Bishop *et al.,* 1978; Sahle and Laszlo 1996; Harris 2009; Goldade and O'Brien 2014). Libby-specific studies to evaluate the potential effect of indirect preparation on reported LA air concentrations show that indirect preparation may increase PCME LA air concentrations by a factor of about 2-3 relative to direct preparation (Berry *et al.,* 2014).

9.7 Data Quality Conclusions

Taken together, these results indicate that data collected as part of the 2011 residential ABS investigation met the objectives set forth in the governing SAPs (CDM Smith 2011, 2012a); collected samples were spatially and temporally representative and the target number of samples and analyses were completed for all ABS scenarios. Additionally, ABS sample filter preparation methods and filter loading are not expected to negatively impact data quality, field and laboratory oversight efforts did not identify any QA issues that would affect data use, and any issues identified during the data verification effort were resolved. However, there was one issue identified that have the potential to affect data quality and result interpretation.

Preliminary information suggests that the laboratory that performed about half of the TEM analyses for ABS air samples collected in this investigation has a narrower definition of the chemical compositions included in the LA assignment, meaning that reported ABS air concentrations in this report have the potential to be biased low.

[14] For three ABS air samples, the HV filter was prepared indirectly without ashing.

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TABLES

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TABLE 4-1

RESULTS FOR SCENARIO 1: "HIGH INTENSITY" VS. "LOW INTENSITY" ABS APPROACH COMPARISON

Libby Asbestos Superfund Site, Libby, Montana

EVENT 1

Property ID	PCME LA Air Concentration (s/cc)					Soil LA Conc. PLM-VE (LA Bin)		Visible Vermiculite								ABS Area Condition		
	"high intensity" ABS script				"low intensity" ABS script			2-pt comp.				30-pt comp.				Mean VWC (%)	Veg. Cover Extent	Veg. Cover Condition
	Raking	Mowing	Digging	Mean		2-pt	30-pt	N	L	M	H	N	L	M	H			
AD-001888	5.9E-03	6.6E-02	9.2E-02	5.5E-02	2.4E-03	C	B1	1	1	0	0	30	0	0	0	15.34%	> 75% cover	Lush
AD-001731	8.9E-02	4.0E-01	2.6E-01	2.5E-01	3.0E-02	B1	B1	0	2	0	0	25	4	1	0	10.02%	25-50% cover	Good
AD-000013	0.0E+00	2.6E-03	0.0E+00	8.7E-04	8.6E-04	A	B1	1	1	0	0	29	1	0	0	8.93%	50-75% cover	Lush
AD-000316	0.0E+00	0.0E+00	6.6E-04	2.2E-04	8.8E-04	B1	A	2	0	0	0	30	0	0	0	21.90%	> 75% cover	Lush
AD-000146	0.0E+00	2.2E-04	4.4E-04	2.2E-04	0.0E+00	A	A	2	0	0	0	30	0	0	0	11.45%	> 75% cover	Sparse
AD-000662	2.9E-03	9.8E-02	2.0E-01	1.0E-01	1.4E-02	B2	B1	0	1	1	0	25	2	3	0	14.4%	> 75% cover	Lush
AD-000065	6.6E-04	7.8E-03	4.4E-04	3.0E-03	2.2E-04	A	A	2	0	0	0	30	0	0	0	10.9%	> 75% cover	Lush
AD-001864	4.2E-03	1.3E-02	2.9E-03	6.7E-03	4.5E-04	B1	B1	2	0	0	0	30	0	0	0	6.78%	50-75% cover	Sparse
AD-001868	1.1E-04	2.2E-04	0.0E+00	1.1E-04	4.4E-04	B1	B1	2	0	0	0	28	2	0	0	14.34%	> 75% cover	Lush
AD-001936	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	A	A	2	0	0	0	30	0	0	0	20.66%	> 75% cover	Lush

EVENT 2

Property ID	PCME LA Air Concentration (s/cc)					Soil LA Conc. PLM-VE (LA Bin)		Visible Vermiculite								ABS Area Condition		
	"high intensity" ABS script				"low intensity" ABS script			2-pt comp.				30-pt comp.				Mean VWC (%)	Veg. Cover Extent	Veg. Cover Condition
	Raking	Mowing	Digging	Mean		2-pt	30-pt	N	L	M	H	N	L	M	H			
AD-001888	6.6E-02	4.1E-03	0.0E+00	2.3E-02	1.9E-01	A	B1	2	0	0	0	30	0	0	0	4.90%	> 75% cover	Lush
AD-001731	7.4E-03	1.9E-02	1.1E-03	9.1E-03	2.2E-02	A	B1	2	0	0	0	27	3	0	0	6.7%	25-50% cover	Good
AD-000013	7.5E-03	4.0E-02	2.1E-04	1.6E-02	6.6E-04	A	B1	2	0	0	0	30	0	0	0	6.1%	25-50% cover	Good
AD-000316	2.2E-04	6.6E-04	0.0E+00	2.9E-04	0.0E+00	B1	A	0	2	0	0	30	0	0	0	17.17%	> 75% cover	Lush
AD-000146	0.0E+00	2.2E-04	0.0E+00	7.3E-05	4.4E-04	A	A	2	0	0	0	30	0	0	0	2.9%	> 75% cover	Sparse
AD-000662	8.8E-04	3.3E-03	9.6E-03	4.6E-03	2.2E-03	B1	B1	0	1	1	0	25	4	1	0	36.7%	> 75% cover	Lush
AD-000065	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E-04	A	A	2	0	0	0	30	0	0	0	17.40%	> 75% cover	Lush
AD-001864	0.0E+00	5.8E-03	0.0E+00	1.9E-03	0.0E+00	A	A	2	0	0	0	30	0	0	0	3.96%	> 75% cover	Sparse
AD-001868	1.1E-02	8.5E-02	1.7E-02	3.8E-02	1.8E-03	C	B2	2	0	0	0	28	2	0	0	13.08%	> 75% cover	Good
AD-001936	0.0E+00	1.2E-03	1.1E-03	7.7E-04	2.2E-04	A	A	1	1	0	0	30	0	0	0	5.34	> 75% cover	Lush

TABLE 4-1

RESULTS FOR SCENARIO 1: "HIGH INTENSITY" VS. "LOW INTENSITY" ABS APPROACH COMPARISON

Libby Asbestos Superfund Site, Libby, Montana

EVENT 3

Property ID	PCME LA Air Concentration (s/cc)					Soil LA Conc. PLM-VE (LA Bin)		Visible Vermiculite								ABS Area Condition		
	"high intensity" ABS script				"low intensity"			2-pt comp.				30-pt comp.				Mean VWC	Veg. Cover	Veg. Cover
	Raking	Mowing	Digging	Mean	ABS script	2-pt	30-pt	N	L	M	H	N	L	M	H	(%)	Extent	Condition
AD-001888						B1	B1	2	0	0	0	30	0	0	0	0-25%	> 75% cover	Good
AD-001731						B1	B2	2	0	0	0	12	14	4	0	8.52%	25-50% cover	Good
AD-000013						A	B1	2	0	0	0	30	0	0	0	3.58%	25-50% cover	Good
AD-000316						B1	A	2	0	0	0	30	0	0	0	25%	> 75% cover	Lush
AD-000146						B1	A	1	1	0	0	30	0	0	0	0.9%	> 75% cover	Sparse
AD-000662						B2	B1	1	0	0	1	17	10	3	0	< 25%	> 75% cover	Lush
AD-000065						A	A	2	0	0	0	30	0	0	0	0-25%	> 75% cover	Good
AD-001864						B1	B1	1	1	0	0	27	3	0	0	0-25%	50-75% cover	Sparse
AD-001868						B2	B2	2	0	0	0	25	5	0	0	3.16%	> 75% cover	Good
AD-001936						A	A	2	0	0	0	30	0	0	0	9.13%	> 75% cover	Lush

ALL SAMPLES ARCHIVED FOR POSSIBLE FUTURE ANALYSIS (PENDING REVIEW OF RESULTS FROM EVENTS 1 AND 2)

Notes:

ABS - activity-based sampling
PCME - phase contrast microscopy equivalent
LA - Libby Amphibole Asbestos
Conc. - concentration
s/cc - structures per cubic centimeter
PLM-VE - polarized light microscopy - visual estimation
pt. - point
comp. - composite
N - none
L - low
M - medium
H - high
VWC - volumetric water content
% - percent
Veg. - vegetative

TABLE 4-2
COMPARISON OF VISIBLE VERMICULITE AND PLM-VE RESULTS FOR SOIL

Panel A: 2011 ABS Soils

	VV -	VV +
Bin A	79	9
Not Bin A	30	22

Concordance: 101/140 (72%)

Panel B: 2007/2008 ABS Soils

	VV -	VV +
Bin A	155	102
Not Bin A	4	50

Concordance: 205/311 (66%)

Notes:

Concordant results are shaded grey.

Based on 30-point soil composite samples only.

VV = visible vermiculite

VV+ = visible vermiculite was observed in one or more sampling points

VV- = visible vermiculite was not observed

PLM-VE = polarized light microscopy - visual estimation

ABS = activity-based sampling

TABLE 5-1
RESULTS FOR SCENARIO 2: 2010 ABS REPEAT
Libby Asbestos Superfund Site, Libby, Montana

EVENT 1

Property ID	EVENT 1						ABS Area Condition		
	PCME LA Air Conc. (s/cc)	Soil LA Conc. PLM-VE (LA Bin)	Visible Vermiculite				Mean VWC (%)	Veg. Cover Extent	Veg. Cover Condition
			N	L	M	H			
Category 1 (no cleanup, Bin B1)									
AD-002501	0.0E+00	B1	29	1	0	0	22.68%	> 75% cover	Good
AD-002515	0.0E+00	B1	23	6	1	0	17.83%	> 75% cover	Good
AD-000025	0.0E+00	B1	27	3	0	0	16.6%	> 75% cover	Lush
Category 2 (cleanup, VV-)									
AD-001732	8.3E-04	A	29	1	0	0	10.6%	> 75% cover	Lush
AD-001853	0.0E+00	B1	30	0	0	0	24.29%	> 75% cover	Lush
Category 3 (cleanup, VV +)									
AD-000444	4.4E-04	B1	30	0	0	0	11.54%	> 75% cover	Good
AD-000146	0.0E+00	A	30	0	0	0	0-25	50-75% cover	Good
Category 4 (cleanup needed, Bin B2 or C)									
AD-002990	4.1E-04	A	28	2	0	0	12%	50-75% cover	Good
AD-000258	0.0E+00	B1	30	0	0	0	16.5%	> 75% cover	Lush
AD-000262	0.0E+00	A	30	0	0	0	33.99%	> 75% cover	Lush
AD-001731	9.0E-03	B2	30	0	0	0	0-25%	50-75% cover	Good

EVENT 2

Property ID	EVENT 2						ABS Area Condition		
	PCME LA Air Conc. (s/cc)	Soil LA Conc. PLM-VE (LA Bin)	Visible Vermiculite				Mean VWC (%)	Veg. Cover Extent	Veg. Cover Condition
			N	L	M	H			
Category 1 (no cleanup, Bin B1)									
AD-002501	2.1E-04	A	29	1	0	0	12.01%	> 75% cover	Good
AD-002515	1.9E-03	B1	29	1	0	0	11.42%	> 75% cover	Good
AD-000025	0.0E+00	A	30	0	0	0	7.9%	> 75% cover	Lush
Category 2 (cleanup, VV-)									
AD-001732	0.0E+00	A	30	0	0	0	8.6%	50-75% cover	Good
AD-001853	0.0E+00	A	26	4	0	0	13.6%	> 75% cover	Lush
Category 3 (cleanup, VV +)									
AD-000444	8.7E-04	B1	28	2	0	0	7.97%	> 75% cover	Good
AD-000146	0.0E+00	A	30	0	0	0	8.49%	25-50% cover	Sparse
Category 4 (cleanup needed, Bin B2 or C)									
AD-002990	0.0E+00	B1	21	5	4	0	9.9%	> 75% cover	Good
AD-000258	4.4E-04	B1	30	0	0	0	12.7%	> 75% cover	Lush
AD-000262	*not collected*								
AD-001731	1.0E-02	B1	25	5	0	0	16.58%	50-75% cover	Good

TABLE 5-1
RESULTS FOR SCENARIO 2: 2010 ABS REPEAT
Libby Asbestos Superfund Site, Libby, Montana

EVENT 3

Property ID	EVENT 3						ABS Area Condition		
	PCME LA Air Conc. (s/cc)	Soil LA Conc. PLM-VE (LA Bin)	Visible Vermiculite				Mean VWC (%)	Veg. Cover Extent	Veg. Cover Condition
			N	L	M	H			
Category 1 (no cleanup, Bin B1)									
AD-002501	0.0E+00	A	30	0	0	0	6.77%	> 75% cover	Good
AD-002515	0.0E+00	B1	28	2	0	0	10.42%	> 75% cover	Good
AD-000025	0.0E+00	A	30	0	0	0	7.4%	50-75% cover	Lush
Category 2 (cleanup, VV-)									
AD-001732	0.0E+00	B1	30	0	0	0	5.55%	50-75% cover	Good
AD-001853	0.0E+00	A	30	0	0	0	20.8%	> 75% cover	Lush
Category 3 (cleanup, VV +)									
AD-000444	0.0E+00	A	29	1	0	0	6.7%	50-75% cover	Good
AD-000146	0.0E+00	B1	29	1	0	0	0-25	25-50% cover	Good
Category 4 (cleanup needed, Bin B2 or C)									
AD-002990	0.0E+00	B1	20	10	0	0	0-25%	50-75% cover	Good
AD-000258	0.0E+00	B1	30	0	0	0	8.7%	> 75% cover	Lush
AD-000262	*not collected*								
AD-001731	4.4E-02	B2	30	0	0	0	0-25%	50-75% cover	Good

Notes:
ABS - activity-based sampling
PCME - phase contrast microscopy-equivalent
LA - Libby amphibole
Conc. - concentration
s/cc - structures per cubic centimeter
PLM-VE - polarized light microscopy - visual estimation
N - none
L - low
M - medium
H - high
VWC - volumetric water content
% - percent
Veg. - vegetative
VV - visible vermiculite

TABLE 5-2
COMPARISON OF ABS AIR CONCENTRATIONS MEASURED IN 2010 AND 2011
Libby Asbestos Superfund Site, Libby, Montana

Property ID	Property Code	PCME LA Air Concentration (s/cc)							
		2011				2010			
		Event 1	Event 2	Event 3	Mean	Event 1	Event 2	Event 3	Mean
Category 1 (no cleanup, Bin B1)									
AD-002501	1	0.0E+00	2.1E-04	0.0E+00	7.1E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00
AD-002515	2	0.0E+00	1.9E-03	0.0E+00	6.4E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00
AD-000025	3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Category 2 (cleanup, Vis-)									
AD-001732	4	8.3E-04	0.0E+00	0.0E+00	2.8E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00
AD-001853	5	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Category 3 (cleanup, Vis +)									
AD-000444	6	4.4E-04	8.7E-04	0.0E+00	4.3E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00
AD-000146	7	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Category 4 (cleanup needed, Bin B2 or C)									
AD-002990	8	4.1E-04	0.0E+00	0.0E+00	1.4E-04	0.0E+00	2.9E-03	0.0E+00	9.8E-04
AD-000258	9	0.0E+00	4.4E-04	0.0E+00	1.5E-04	0.0E+00	1.5E-03	0.0E+00	4.8E-04
AD-000262	10	0.0E+00	*not collected*		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
AD-001731	11	9.0E-03	1.0E-02	4.4E-02	2.1E-02	1.4E-03	1.9E-03	9.9E-04	1.4E-03

Notes:

ABS - activity-based sampling

PCME - phase contrast microscopy equivalent

LA - Libby Amphibole Asbestos

s/cc - structures per cubic centimeter

TEM - transmission light microscopy

based on pooled result (i.e., includes supplemental TEM analysis results)

TABLE 6-1
RESULTS FOR SCENARIO 3: MOWING WITH/WITHOUT IRRIGATION
Libby Asbestos Superfund Site, Libby, Montana

Property ID	Irrigation Status	Event	Sample Date	PCME LA Air Conc. (s/cc)		Soil LA Conc. PLM-VE (LA Bin)	Visible Vermiculite				ABS Area Condition			
											Mean VWC (%)		Veg. Cover Extent	Veg. Cover Condition
				sample	*mean*		N	L	M	H	pre-irr.	post-irr.		
AD-000769	with	2	7/28/2011	6.4E-04	*2.1E-04*	A	30	0	0	0	21.1%	24.6%	> 75% cover	Lush
		4	8/25/2011	0.0E+00		A	30	0	0	0	26.9%	27.1%	> 75% cover	Lush
		6	9/23/2011	0.0E+00		B1	30	0	0	0	< 25%*	NR	> 75% cover	Lush
	without	1	7/14/2011	0.0E+00	*7.2E-05*	B1	30	0	0	0	28.8%	---	> 75% cover	Lush
		3	8/11/2011	0.0E+00		B1	30	0	0	0	27.2%	---	> 75% cover	Lush
		5	9/10/2011	2.2E-04		B1	27	3	0	0	< 25%*	---	> 75% cover	Lush
AD-001587	with	2	7/28/2011	4.3E-04	*1.4E-04*	B1	30	0	0	0	7.32%	6.32%	> 75% cover	Good
		4	8/26/2011	0.0E+00		B1	30	0	0	0	6.44%	6.28%	> 75% cover	Good
		6	9/23/2011	0.0E+00		A	30	0	0	0	< 25%*	NR	> 75% cover	Good
	without	1	7/14/2011	0.0E+00	*0.0E+00*	B1	30	0	0	0	16.175%	---	> 75% cover	Lush
		3	8/11/2011	0.0E+00		A	27	3	0	0	6.96%	---	> 75% cover	Good
		5	9/10/2011	0.0E+00		A	30	0	0	0	< 25%*	---	> 75% cover	Good
AD-001867	with	2	7/28/2011	2.2E-04	*7.3E-05*	A	30	0	0	0	5.99%	8.80%	50-75% cover	Good
		4	8/26/2011	0.0E+00		A	30	0	0	0	7.95%	10.1%	> 75% cover	Good
		6	9/23/2011	0.0E+00		A	30	0	0	0	< 25%*	NR	> 75% cover	Good
	without	1	7/14/2011	2.2E-04	*7.3E-05*	A	30	0	0	0	13.2%	---	50-75% cover	Good
		3	8/11/2011	0.0E+00		A	28	2	0	0	3.53%	---	50-75% cover	Good
		5	9/10/2011	0.0E+00		A	30	0	0	0	< 25%*	---	> 75% cover	Lush

Notes:
*Used "Hand Appearance Method" from Outdoor ABS SAP, result was 75% moisture deficient
ABS - activity-based sampling
PCME - phase contrast microscopy-equivalent
LA - Libby amphibole
Conc. - concentration
s/cc - structures per cubic centimeter
PLM-VE - polarized light microscopy - visual estimation
N - none
L - low
M - medium
H - high
VWC - volumetric water content
% - percent
Veg. - vegetative
irr. - irrigation
NR = not recorded

TABLE 7-1
RESULTS FOR SCENARIO 4: CURB-TO-CURB PROPERTIES
Libby Asbestos Superfund Site, Libby, Montana

EVENT 1

Property ID	Soil Removal Date	EVENT 1						ABS Area Condition		
		PCME LA Air Conc. (s/cc)	Soil LA Conc. PLM-VE (LA Bin)	Visible Vermiculite				Mean VWC (%)	Veg. Cover Extent	Veg. Cover Condition
				N	L	M	H			
AD-001713	Jun-08	2.2E-04	A	30	0	0	0	9.3%	50-75% cover	Sparse
AD-002171	Oct-10	0.0E+00	A	30	0	0	0	8.2%	50-75% cover	Good
AD-001722	Jun-08	0.0E+00	A	30	0	0	0	13.4%	> 75% cover	Good
AD-002292	Jun-10	0.0E+00	A	30	0	0	0	5.51%	> 75% cover	Sparse
AD-001893	Jul-08	0.0E+00	A	30	0	0	0	26.22%	> 75% cover	Lush
AD-003155	May-10	0.0E+00	A	30	0	0	0	15.91%	> 75% cover	Good
AD-000414	Oct-08	1.1E-02	A	30	0	0	0	7.92%	> 75% cover	Lush
AD-004749	Jun-10	0.0E+00	A	30	0	0	0	28.9%	> 75% cover	Good
AD-004293	Jun-10	1.1E-04	A	29	1	0	0	26.7%	> 75% cover	Lush
AD-000353	Jul-09	6.6E-04	A	30	0	0	0	10.54%	> 75% cover	Lush
AD-001904	Jul-09	0.0E+00	A	30	0	0	0	20.51%	> 75% cover	Lush

EVENT 2

Property ID	Soil Removal Date	EVENT 2						ABS Area Condition		
		PCME LA Air Conc. (s/cc)	Soil LA Conc. PLM-VE (LA Bin)	Visible Vermiculite				Mean VWC (%)	Veg. Cover Extent	Veg. Cover Condition
				N	L	M	H			
AD-001713	Jun-08	1.2E-02	A	30	0	0	0	2.54%	50-75% cover	Sparse
AD-002171	Oct-10	0.0E+00	A	30	0	0	0	15.6%	50-75% cover	Good
AD-001722	Jun-08	4.6E-04	A	30	0	0	0	12.09%	> 75% cover	Good
AD-002292	Jun-10	6.5E-04	A	30	0	0	0	6.95%	25-50% cover	Sparse
AD-001893	Jul-08	0.0E+00	A	30	0	0	0	25.96%	> 75% cover	Lush
AD-003155	May-10	0.0E+00	A	30	0	0	0	18.46%	50-75% cover	Good
AD-000414	Oct-08	0.0E+00	A	30	0	0	0	8.7%	50-75% cover	Good
AD-004749	Jun-10	0.0E+00	A	30	0	0	0	26.28%	> 75% cover	Good
AD-004293	Jun-10	*not collected*								
AD-000353	Jul-09	0.0E+00	A	30	0	0	0	8.7%	25-50% cover	Sparse
AD-001904	Jul-09	0.0E+00	A	30	0	0	0	29.04%	> 75% cover	Lush

TABLE 7-1
RESULTS FOR SCENARIO 4: CURB-TO-CURB PROPERTIES
Libby Asbestos Superfund Site, Libby, Montana

EVENT 3

Property ID	Soil Removal Date	EVENT 3						ABS Area Condition		
		PCME LA Air Conc. (s/cc)	Soil LA Conc. PLM-VE (LA Bin)	Visible Vermiculite				Mean VWC (%)	Veg. Cover Extent	Veg. Cover Condition
				N	L	M	H			
AD-001713	Jun-08	1.1E-03	A	30	0	0	0	1.66%	25-50% cover	Good
AD-002171	Oct-10	0.0E+00	A	30	0	0	0	0-25%	50-75% cover	Good
AD-001722	Jun-08	0.0E+00	B1	30	0	0	0	0-25%	> 75% cover	Good
AD-002292	Jun-10	0.0E+00	A	30	0	0	0	0-25%	25-50% cover	Sparse
AD-001893	Jul-08	0.0E+00	A	30	0	0	0	0-25%	> 75% cover	Lush
AD-003155	May-10	0.0E+00	A	30	0	0	0	0-25%	> 75% cover	Good
AD-000414	Oct-08	0.0E+00	A	27	3	0	0	1.38%	> 75% cover	Good
AD-004749	Jun-10	0.0E+00	A	30	0	0	0	0-25%	NR	NR
AD-004293	Jun-10	*not collected*								
AD-000353	Jul-09	0.0E+00	A	30	0	0	0	7.51%	50-75% cover	Sparse
AD-001904	Jul-09	0.0E+00	A	30	0	0	0	0-25%	> 75% cover	Lush

based on pooled result (i.e., includes supplemental TEM analysis results)

Notes:
ABS - activity-based sampling
PCME - phase contrast microscopy-equivalent
LA - Libby amphibole
Conc. - concentration
s/cc - structures per cubic centimeter
PLM-VE - polarized light microscopy - visual estimation
N - none
L - low
M - medium
H - high
VWC - volumetric water content
% - percent
Veg. - vegetative
NR = not recorded
TEM - transmission electron microscopy

TABLE 8-1
RESULTS FOR SCENARIO 5: LIMITED-USE AREAS
Libby Asbestos Superfund Site, Libby, Montana

EVENT 1

Property ID	EVENT 1							ABS Area Condition		
	PCME LA Air Conc. (s/cc)		Soil LA Conc. PLM-VE (LA Bin)	Visible Vermiculite				Mean VWC (%)	Veg. Cover Extent	Veg. Cover Condition
	Rider #1	Rider #2		N	L	M	H			
Category 1 (Bin A and Vis -)										
AD-003164	0.0E+00	0.0E+00	A	30	0	0	0	0.2%	5-25%	poor
AD-004423	0.0E+00	0.0E+00	A	30	0	0	0	< 25%*	50-75%	good
AD-001855	0.0E+00	0.0E+00	B1	30	0	0	0	7.97%	>75%	lush
AD-001855	1.7E-03	0.0E+00	A	30	0	0	0	< 25%*	>75%	good
AD-002645	0.0E+00	0.0E+00	A	30	0	0	0	< 25%*	>75%	good
Category 2 (Bin B1 or greater and/or Vis +)										
AD-005707	1.0E-02	0.0E+00	A	30	0	0	0	< 25%*	5-25%	poor
AD-003164	0.0E+00	0.0E+00	A	30	0	0	0	12.7%	50-75%	good
AD-002206	0.0E+00	0.0E+00	B1	30	0	0	0	< 25%*	>75%	good
AD-000157	0.0E+00	0.0E+00	B1	30	0	0	0	2.65%	50-75%	lush
AD-004423	1.7E-03	1.0E-02	B1	30	0	0	0	< 25%*	<5%	NR

EVENT 2

Property ID	EVENT 2							ABS Area Condition		
	PCME LA Air Conc. (s/cc)		Soil LA Conc. PLM-VE (LA Bin)	Visible Vermiculite				Mean VWC (%)	Veg. Cover Extent	Veg. Cover Condition
	Rider #1	Rider #2		N	L	M	H			
Category 1 (Bin A and Vis -)										
AD-003164	7.0E-03	1.6E-02	B1	30	0	0	0	2.2%	5-25%	poor
AD-004423	5.2E-03	0.0E+00	A	30	0	0	0	< 25%*	50-75%	good
AD-001855	0.0E+00	0.0E+00	A	30	0	0	0	7.97%	>75%	lush
AD-001855	1.7E-03	3.5E-03	A	30	0	0	0	NR	NR	NR
AD-002645	0.0E+00	0.0E+00	A	30	0	0	0	< 25%*	>75%	good
Category 2 (Bin B1 or greater and/or Vis +)										
AD-005707	1.2E-02	0.0E+00	A	30	0	0	0	< 25%*	5-25%	poor
AD-003164	0.0E+00	0.0E+00	A	30	0	0	0	1.25%	50-75%	good
AD-002206	0.0E+00	0.0E+00	B1	30	0	0	0	< 25%*	>75%	good
AD-000157	0.0E+00	3.5E-03	B1	30	0	0	0	6.38%	50-75%	lush
AD-004423	1.4E-02	7.0E-03	B1	30	0	0	0	NR	NR	NR

TABLE 8-1
RESULTS FOR SCENARIO 5: LIMITED-USE AREAS
Libby Asbestos Superfund Site, Libby, Montana

EVENT 3

Property ID	EVENT 3							ABS Area Condition		
	PCME LA Air Conc. (s/cc)		Soil LA Conc. PLM-VE (LA Bin)	Visible Vermiculite				Mean VWC (%)	Veg. Cover Extent	Veg. Cover Condition
	Rider #1	Rider #2		N	L	M	H			
Category 1 (Bin A and Vis -)										
AD-003164	1.2E-02	1.4E-02	A	30	0	0	0	2.2%	5-25%	poor
AD-004423	3.5E-03	0.0E+00	A	30	0	0	0	< 25%*	50-75%	poor-good
AD-001855	4.6E-03	0.0E+00	A	30	0	0	0	7.97%	>75%	lush
AD-001855	1.7E-03	0.0E+00	A	30	0	0	0	NR	NR	NR
AD-002645	0.0E+00	0.0E+00	A	30	0	0	0	< 25%*	NR	NR
Category 2 (Bin B1 or greater and/or Vis +)										
AD-005707	1.7E-02	3.5E-03	A	30	0	0	0	< 25%*	5-25%	poor
AD-003164	0.0E+00	0.0E+00	A	30	0	0	0	4.64%	50-75%	good
AD-002206	0.0E+00	0.0E+00	A	30	0	0	0	< 25%*	>75%	good
AD-000157	0.0E+00	0.0E+00	B1	30	0	0	0	4.37%	50-75%	lush
AD-004423	1.4E-02	1.4E-02	A	30	0	0	0	NR	NR	NR

Notes:
*Used "Hand Appearance Method" from Outdoor ABS SAP, result was 75% moisture deficient
ABS - activity-based sampling
PCME - phase contrast microscopy equivalent
LA - Libby Amphibole Asbestos
s/cc - structures per cubic centimeter
PLM-VE - polarized light microscopy - visual estimation
pt. - point
comp. - composite
N - none
L - low
M - medium
H - high
VWC - volumetric water content
% - percent
Veg. - vegetative
NR - not recorded

Table 9-1. Data Quality Impact Assessment for Field Modifications

ROM Number	Effective Date	Description	Impact on Data Quality
LFO-000160	8/18/2011	The following revisions were made to the SAP text: • Change the RfC from 0.00001 to 0.00002 f/cc (Section 3.5.1). Adjust the target sensitivity to reflect this change (Section 3.7.1 and Section 5.2.2). • Add the subsequent analysis of 5% of low volume ABS air filters to provide information on sampling variability (similar to a field duplicate) (Section 4.5.3). • Add text to clarify that selection of soil samples for preparation by FBAS will be based upon a review of PLM results and initial ABS air results (Section 5.1.1). • Include citation of laboratory permanent ROMs LB-000016 and LB-000028 to the TEM analysis sections for FBAS air filters (Section 5.1.3) and ABS air filters (Section 5.2.1). • Modify the TEM analysis approach for FBAS air filters to use a two-tier magnification approach (Section 5.1.3). • Add new section (Section 5.2.4) to summarize the transmittal of preliminary ABS air sample results after the examination of the first 200 grid openings. • Adjust the frequency rate for TEM recount analyses from 2.5 percent to 3 percent (Section 5.6.2). • Make appropriate changes to the Analytical Requirements Summary (Appendix E) to reflect the above changes.	No negative implications; changes will standardize analytical procedures for the ABS program.
LFO-000161	9/29/2012	Rainfall was noted by the sampling team at 16:21 during Event 1 "without irrigation" mowing at 107 Yellowtail Rd but the sampling event was continued until the entire yard was mowed.	Rainfall may minimize airborne dust during ABS sampling. Air samples may be biased low.
		The volumetric water content (VWC) of the soil measured before Event 1 at 427 Reserve Rd exceeded the maximum average VWC allowed for ABS events (30%). The VWC was 34% at 10:22. The soil moisture content was not measured before the event started at 12:04. Light rainfall was noted by the sampling team at 12:02 just before starting Event 1.	Rainfall and high soil moisture content may minimize airborne dust during ABS sampling. Air samples may be biased low.
		Only the back yard was sampled at 34 White Ave during all three ABS events because the pathway to front yard was obstructed by the homeowner's belongings.	This is a curb-to-curb removal property. Soil and air samples are not expected to be biased high or low.
		During Scenario 2 events at 226 Spencer Rd, the entire yard was not sampled due to confusion over the ABS area. During Event 1, ABS area was the same as the Scenario 1 ABS area. During Events 2 and 3, the grassy areas behind the house by the alley were added to the ABS area but the area between the front yard fence and Spencer Rd was not sampled.	Soil and air samples from Event 1 may be biased low because historically, low levels of vermiculite have been observed in the areas near the alley. There are no anticipated negative implications of the modification to Event 2 as the omitted area had soil removal and no vermiculite or LA have been observed.
		The entire yard was not sampled at 245 Bowen Hill Rd. Instead of spreading out the activities within the entire yard, a different section of the yard was sampled during each event and all activities were done within the chosen section.	Historically the entire ABS area has been classified as Bin B1 (<0.2% LA PLM-VE) with no visible vermiculite. There are no anticipated negative implications of the modification.
		The Tygon tubing between the air cassette and the 2010 high volume pump disconnected during Event 2 2010 raking activity at 912 California Ave. Thus, the 2010 and 2007/2008 raking samples were not taken concurrently.	There are no anticipated negative implications of the modification as the samples were taken on the same day and a 20 minute break was taken before resuming the 2010 yard work activities.
		During Scenario 1, the field teams took less than 20 minutes of break between tasks (i.e., raking and adult digging, child's play digging, and mowing).	The 2010 sample may be biased high as a result of residual airborne dust from the preceding 2007/2008 tasks.
		The soil moisture meter appeared to be malfunctioning starting on August 16. The soil moisture meter was repaired by the vendor but broke again in early September. ABS events were continued as scheduled using the "hand squeeze" method to determine if the soil was sufficiently dry to perform ABS.	There are no anticipated negative implications of this modification. Under this method, ABS would only be performed if the soil moisture deficiency is 75-100%. This is more stringent than the maximum average volumetric water content of 30%.
		Pump flow was checked less frequently than every 30 minutes for some ABS events.	There are no anticipated negative implications of this modification. The pump flows were within acceptable range when they were checked.
LFO-000162	8/22/2011	The following revisions were made to the SAP text: • Change the RfC from 0.00001 to 0.00002 f/cc (Section 2.1.5). Adjust the target sensitivity to reflect this change (Section 2.2.5). • Remove Category 3 from LUA ABS scenario (Section 2.2.1) • Make appropriate changes to the Analytical Requirements Summary (Appendix E) to reflect the above changes.	No negative implications; changes will standardize analytical procedures for the ABS program.

Table 9-1. Data Quality Impact Assessment for Field Modifications

ROM Number	Effective Date	Description	Impact on Data Quality
LFO-000172	10/13/2011	Soil moisture reading was taken once at the beginning of the day instead of before each event. Soil moisture readings for Event 1 will be assumed for subsequent events (Events 2 and 3).	There are no anticipated negative implications of this modification. The volumetric water content of the LUA was approximately 8% in the morning. It is anticipated that moisture content would be similar or less during Events 2 and 3.
		The soil moisture meter appeared to be malfunctioning, giving an under range error for any location sampled starting on September 7. ABS events were continued as scheduled. During this time, to determine if the soil was sufficiently dry, the hand appearance method from Sampling and Analysis Plan for Activity-Based Outdoor Air Exposures, Operable Unit 4, July 6, 2007 Section 4.2.2 was used.	There are no anticipated negative implications of this modification. Under this method, ABS would only be performed if the soil moisture deficiency is 75-100%. This would result in average volumetric water content below the required 30%.
		A field air blank was collected before each event on the following dates: 8/24/11; 8/25/11; 9/6/11 – 9/9/11; 9/12/11; 9/14/11; 9/16/11; 9/17/11. Three events within the same ABS area occurred on those days, resulting in three field blanks from the same ABS area on the same day. The modification affects all LUA ABS areas.	Additional field blanks may be required to be analyzed as a result of three field blanks being collected on the same day from the same ABS area.

Table 9-2
Comparison of Soil Field Duplicate Result to Original Result

		Field Duplicate Results			
		Bin A	**Bin B1**	**Bin B2**	**Bin C**
Original Results	**Bin A**	3	1	0	0
	Bin B1	3	2	0	0
	Bin B2	0	0	0	0
	Bin C	0	0	0	0

total number of duplicates	9	
number concordant	5	(grey shaded cells)
percent concordant	56%	

TABLE 9-3
TARGET AND ACTUAL NUMBER OF SAMPLES COLLECTED AND ANALYZED

Panel A: ABS Air Samples

Scenario	Air Samples Collected		Air Samples Analyzed		Completeness
	Target	Actual	Target	Actual	
1 (07/08 script)	10 x 3 x 6 = 180 [a]	180	90 [e]	60 [f]	67%
1 (2010 script)	10 x 3 x 1 = 30 [b]	30	30	20 [f]	67%
2	10 x 3 x 2 = 60 [c]	62	30 [e]	31	103%
3	6 x 3 x 2 = 36 [d]	36	18 [e]	18	100%
4	10 x 3 x 2 = 60 [c]	62	30 [e]	31	103%
5	10 x 3 x 2 x 2 = 120 [g]	118	60 [e]	60	100%
Total	**486**	**488**	**258**	**220**	**85%**

[a] 10 properties x 3 sampling events per property x 6 HV/LV ABS air sample pairs per sampling event
[b] 10 properties x 3 sampling events per property x 1 HV ABS air sample per sampling event
[c] 10 properties x 3 sampling events per property x 2 HV/LV ABS air sample pairs per sampling event
[d] 6 properties x 3 sampling events per property x 2 HV/LV ABS air sample pairs per sampling event
[e] Either the HV or the paired LV ABS air sample was analyzed.
[f] Samples from Event 3 were not analyzed.
[g] 10 ABS areas (7 properties) x 3 sampling events per ABS area x 2 ATV riders x 2 HV/LV ABS air sample pairs per sampling event

Panel B: Soil Samples

Scenario	Soil Samples Collected		Soil Samples Analyzed		Completeness
	Target	Actual	Target	Actual	
1	10 x 3 x 2 = 60 [a]	60	60	60	100%
2	10 x 3 x 1 = 30 [b]	31	30	31	103%
3	6 x 3 x 1 = 18 [c]	18	18	18	100%
4	10 x 3 x 1 = 30 [b]	31	30	31	103%
5	10 x 3 x 1 = 30 [d]	30	30	30	100%
Total	**168**	**170**	**168**	**170**	**101%**

[a] 10 properties x 3 sampling events per property x 2 soil samples per sampling event (one 2-pt composite and one 30-pt composite)
[b] 10 properties x 3 sampling events per property x 1 soil sample per sampling event
[c] 6 properties x 3 sampling events per property x 1 soil sample per sampling event
[d] 10 ABS areas (7 properties) x 3 sampling events per ABS area x 1 soil sample per sampling event

Notes:
ABS – activity-based sampling
HV – high volume
LV – low volume
ATV – all-terrain vehicle
pt. – point

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FIGURES

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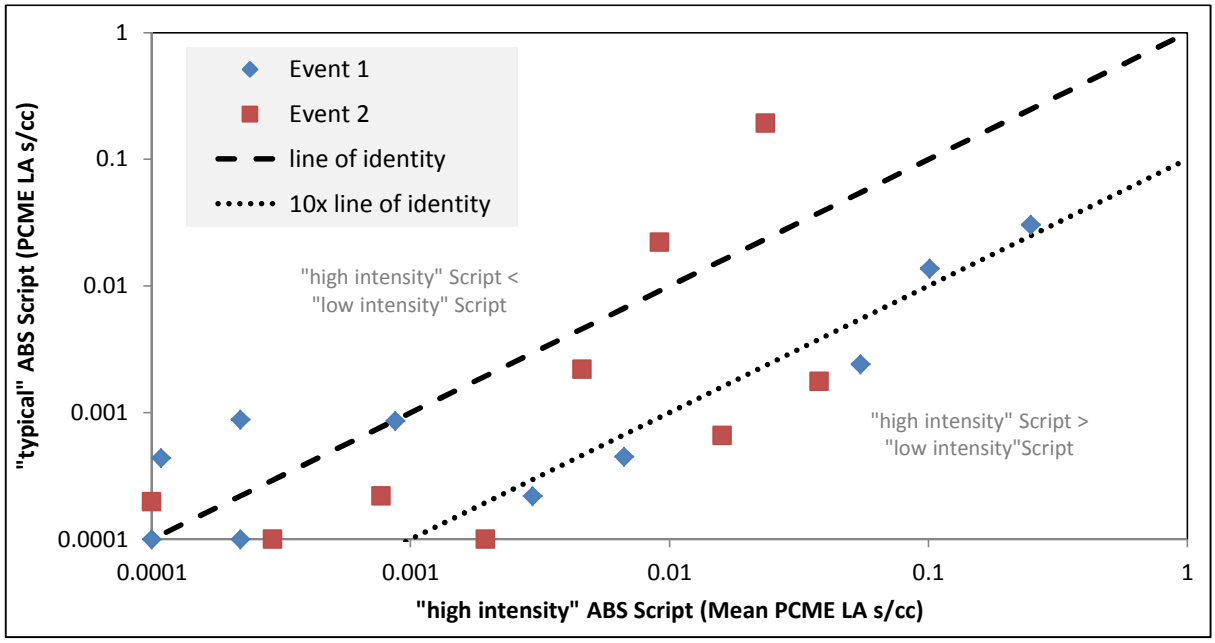
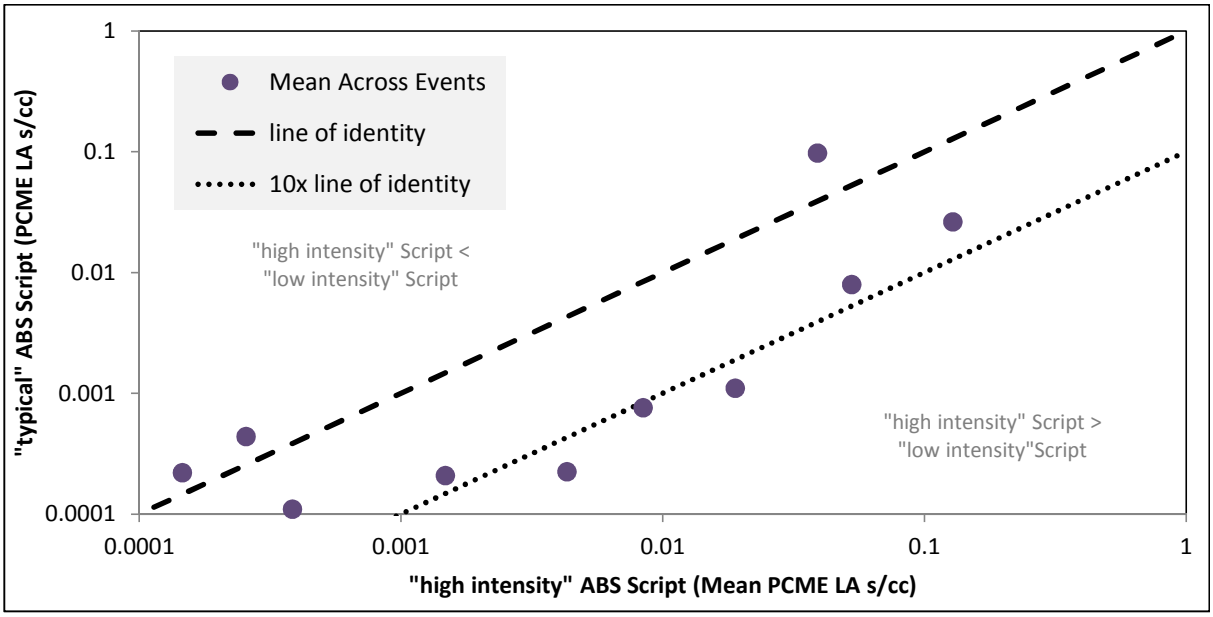
FIGURE 4-1
COMPARISON OF ABS AIR CONCENTRATIONS FOR TWO DIFFERENT ABS SCRIPTS

Panel A: Comparison of ABS Air Concentrations (By Event)



Panel B: Comparison of Mean ABS Air Concentrations (Across Events)



Notes:

Non-detects are plotted at 0.0001 s/cc.

ABS - activity based sampling

PCME - phase contrast microscopy-equivalent

LA - Libby amphibole

s/cc - structures per cubic centimeter

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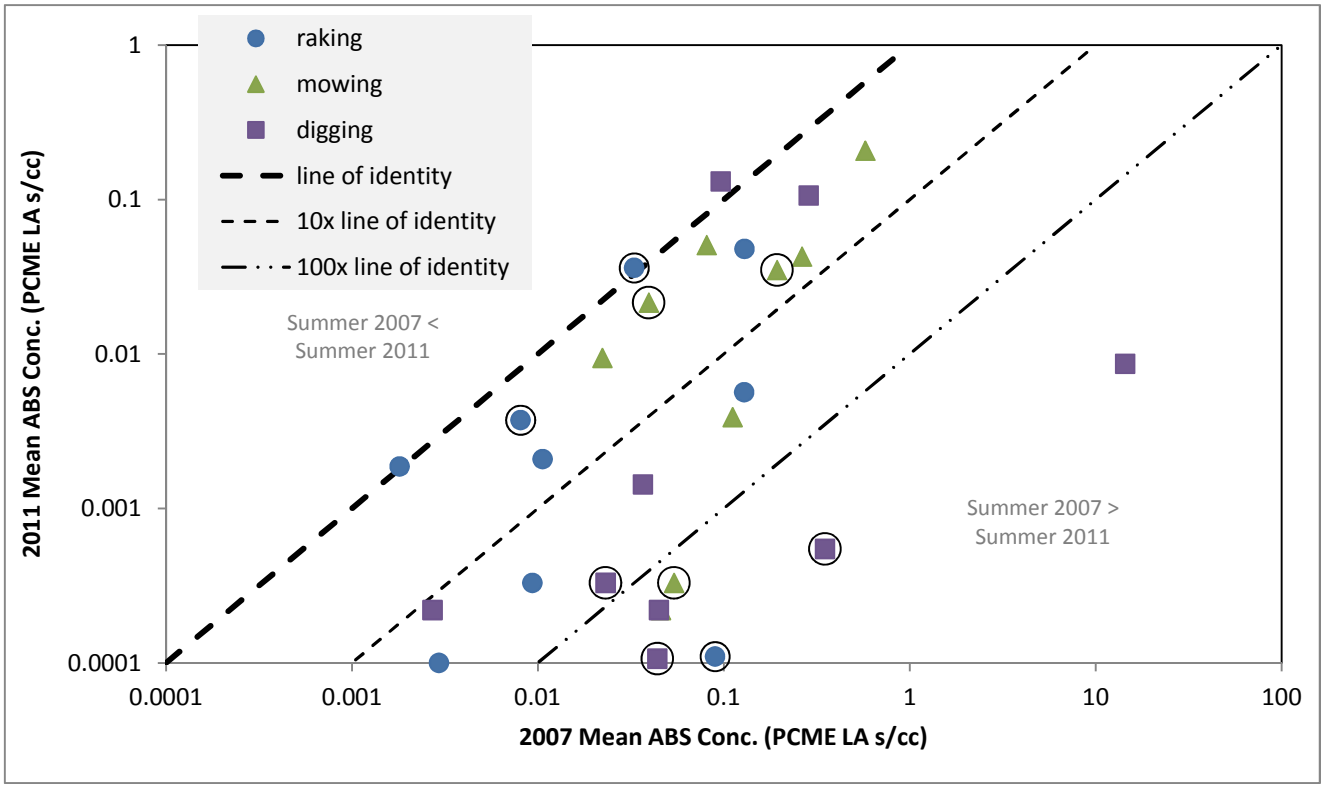
FIGURE 4-2
COMPARISON OF ABS AIR CONCENTRATIONS FOR TWO DIFFERENT YEARS



Notes:

Non-detects are plotted at 0.0001 s/cc.

Summer 2007 ABS air samples that had a sampling duration less than 30 minutes are circled.

ABS - activity-based sampling

PCME - phase contrast microscopy-equivalent

LA - Libby amphibole

s/cc - structures per cubic centimeter

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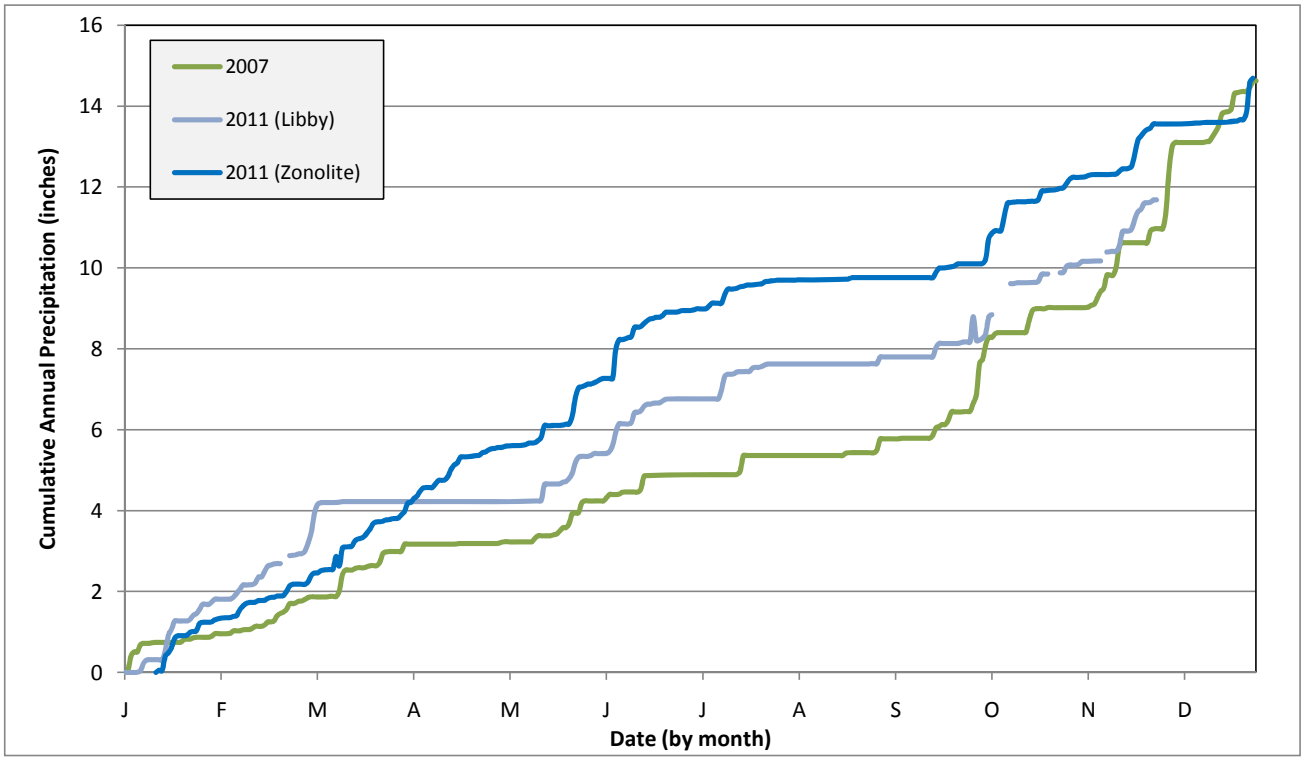
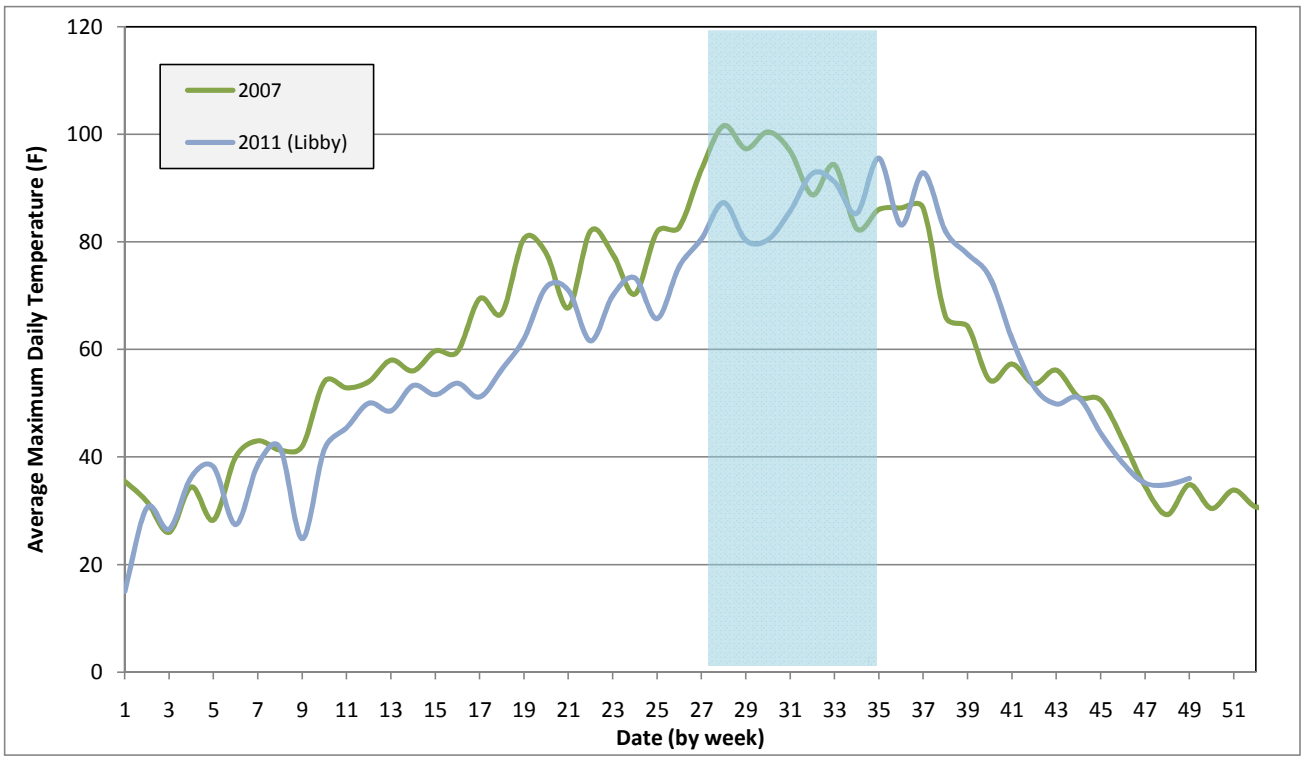
FIGURE 4-3
COMPARISON OF METEOROLOGICAL CONDITIONS IN 2007 AND 2011

Panel A: Cumulative Precipitation



Panel B: Maximum Daily Temperature



Note: For 2011, precipitation results (Panel A) are shown for both the Libby station (LBBM8) and the mine station (ZONM8). This is because of a suspected issue with the reported data for Libby station from March through May.

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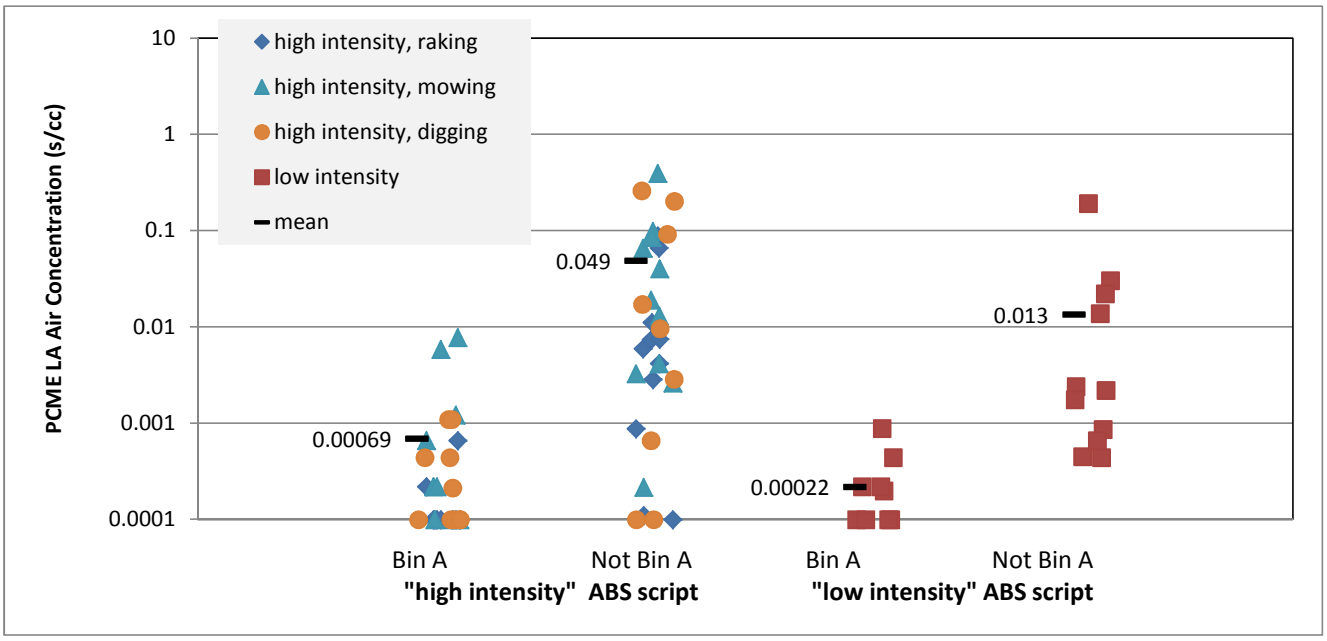
FIGURE 4-4

CORRELATION OF ABS AIR CONCENTRATIONS TO SOIL PLM-VE RESULTS FOR SCENARIO 1



Notes:

Non-detects are plotted at 0.0001 s/cc.

ABS - activity-based sampling

PLM-VE - polarized light microscopy - visual estimation

PCME - phase contrast microscopy-equivalent

LA - Libby amphibole

s/cc - structures per cubic centimeter

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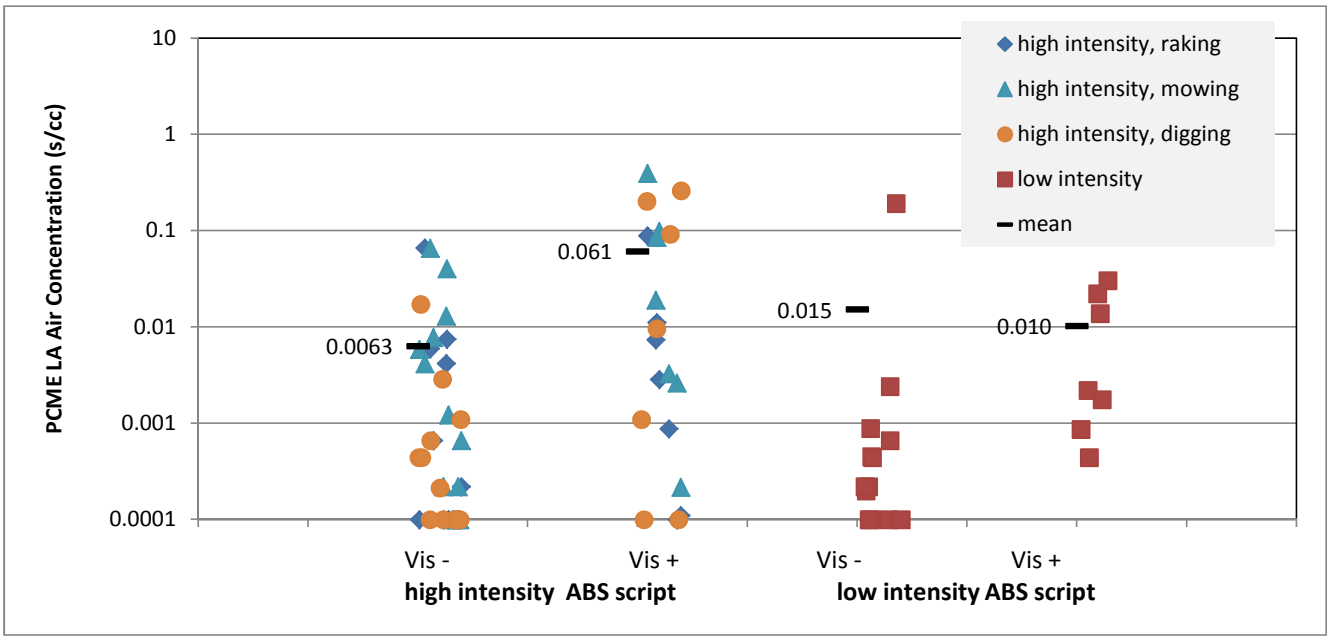
FIGURE 4-5

CORRELATION OF ABS AIR CONCENTRATIONS TO SOIL VISIBLE VERMICULITE RESULTS FOR SCENARIO 1



Notes:

Non-detects are plotted at 0.0001 s/cc.

ABS - activity-based sampling

PCME - phase contrast microscopy-equivalent

LA - Libby amphibole

s/cc - structures per cubic centimeter

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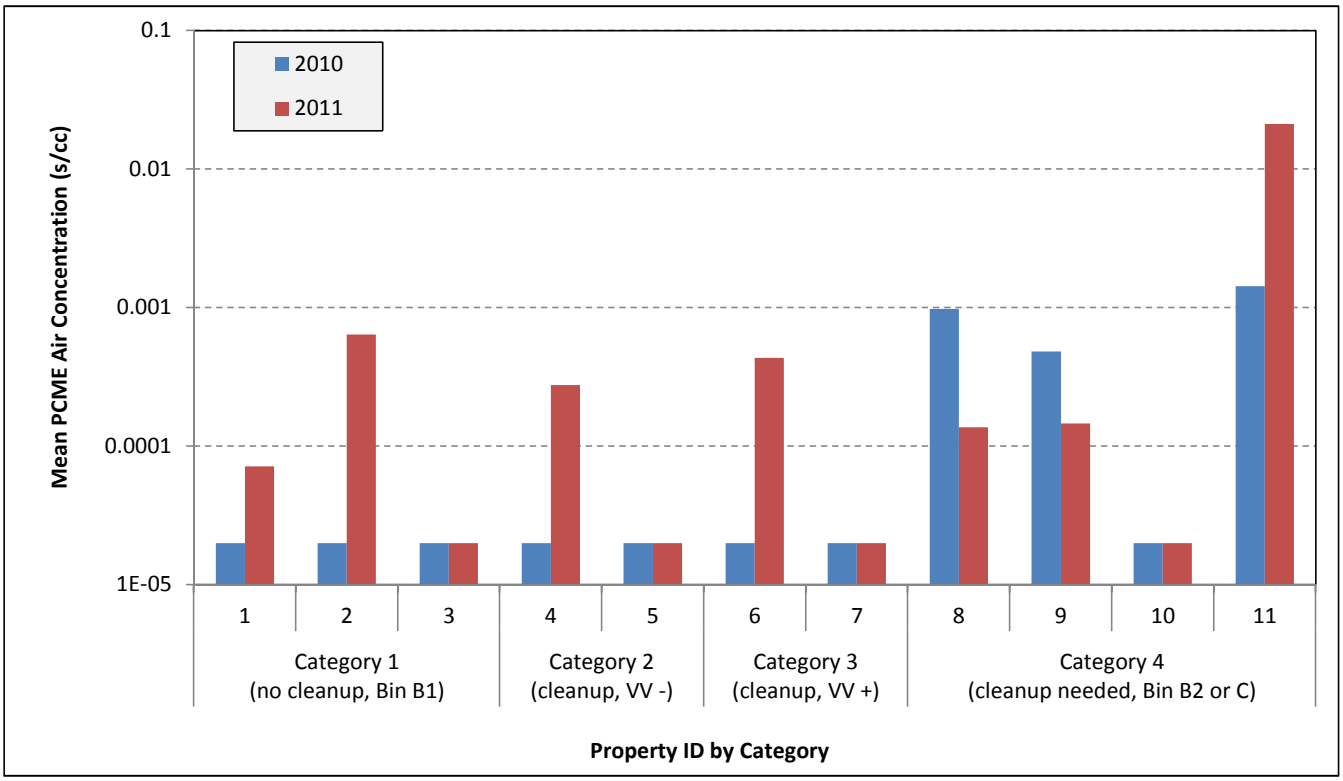
FIGURE 5-1

MEAN ABS AIR CONCENTRATIONS FROM THE 2010 AND 2011 STUDIES FOR SCENARIO 2



Notes:

Non-detects are plotted at 2E-05 s/cc.

ABS - activity based sampling

PCME - phase contrast light microscopy

LA - Libby amphibole

s/cc - structures per cubic centimeter

VV - visible vermiculite

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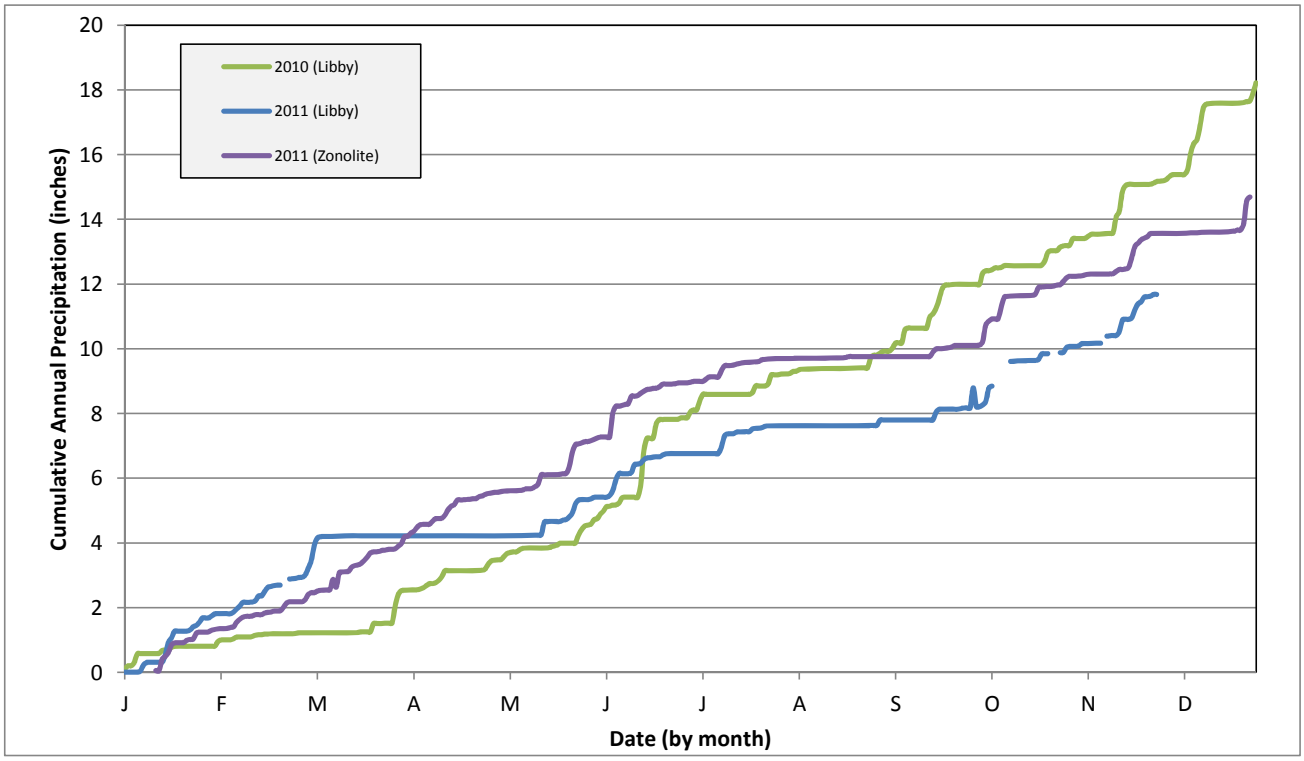
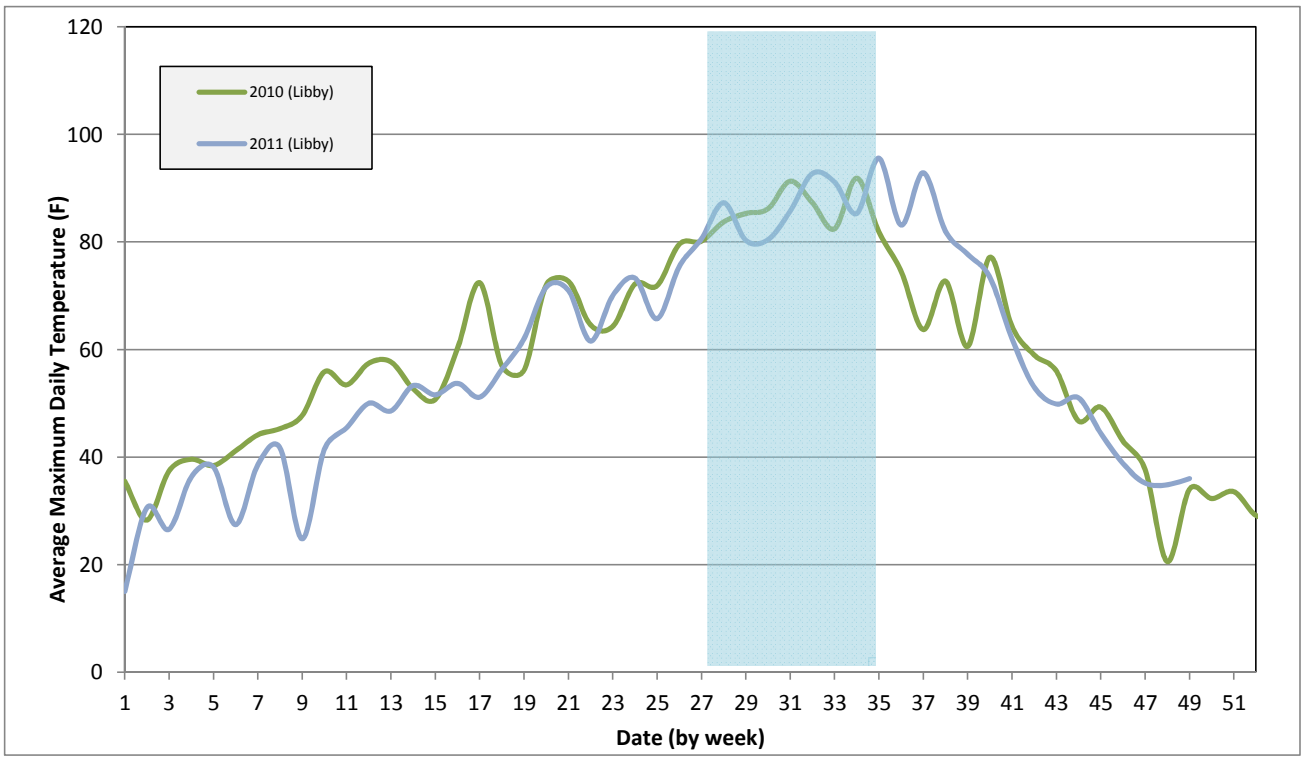
FIGURE 5-2
COMPARISON OF METEOROLOGICAL CONDITIONS IN 2010 AND 2011

Panel A: Cumulative Precipitation



Panel B: Maximum Daily Temperature



Note: For 2011, precipitation results (Panel A) are shown for both the Libby station (LBBM8) and the mine station (ZONM8). This is because of a suspected issue with the reported data for Libby station from March through May.

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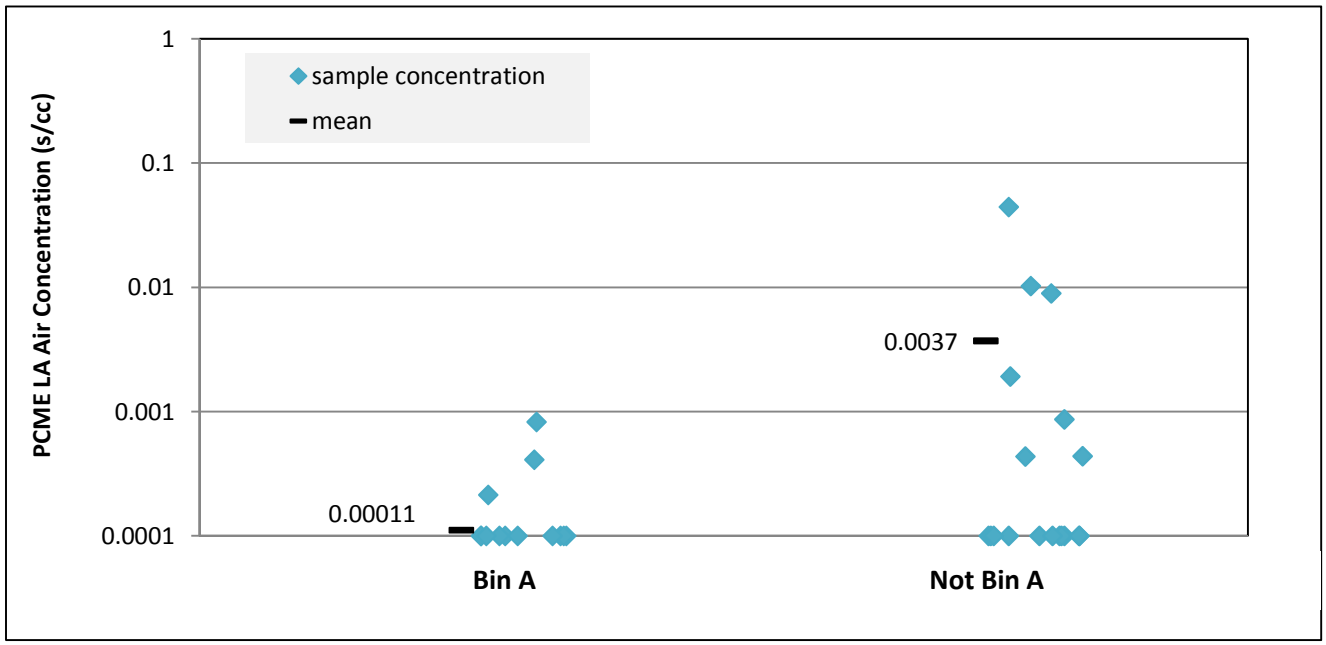
FIGURE 5-3

CORRELATION OF ABS AIR CONCENTRATIONS TO SOIL PLM-VE RESULTS FOR SCENARIO 2



Notes:

Non-detects are plotted at 0.0001 s/cc.

ABS - activity based sampling

PLM-VE - polarized light microscopy visual estimation

PCME - phase contrast light microscopy

LA - Libby Amphibole

s/cc - structures per cubic centimeter

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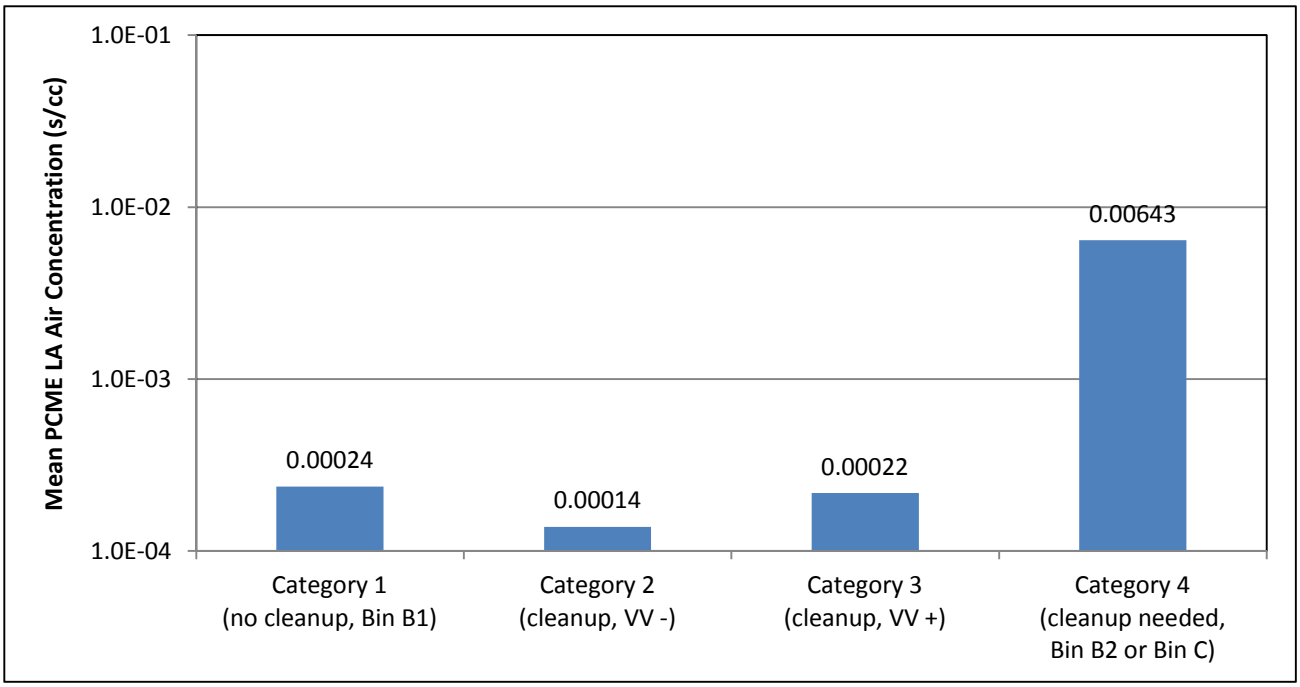
FIGURE 5-4

RELATION OF ABS AIR CONCENTRATIONS TO SOIL CLEANUP STATUS



Notes:

ABS - activity based sampling

PCME - phase contrast light microscopy

LA - Libby Amphibole

s/cc - structures per cubic centimeter

VV - visible vermiculite

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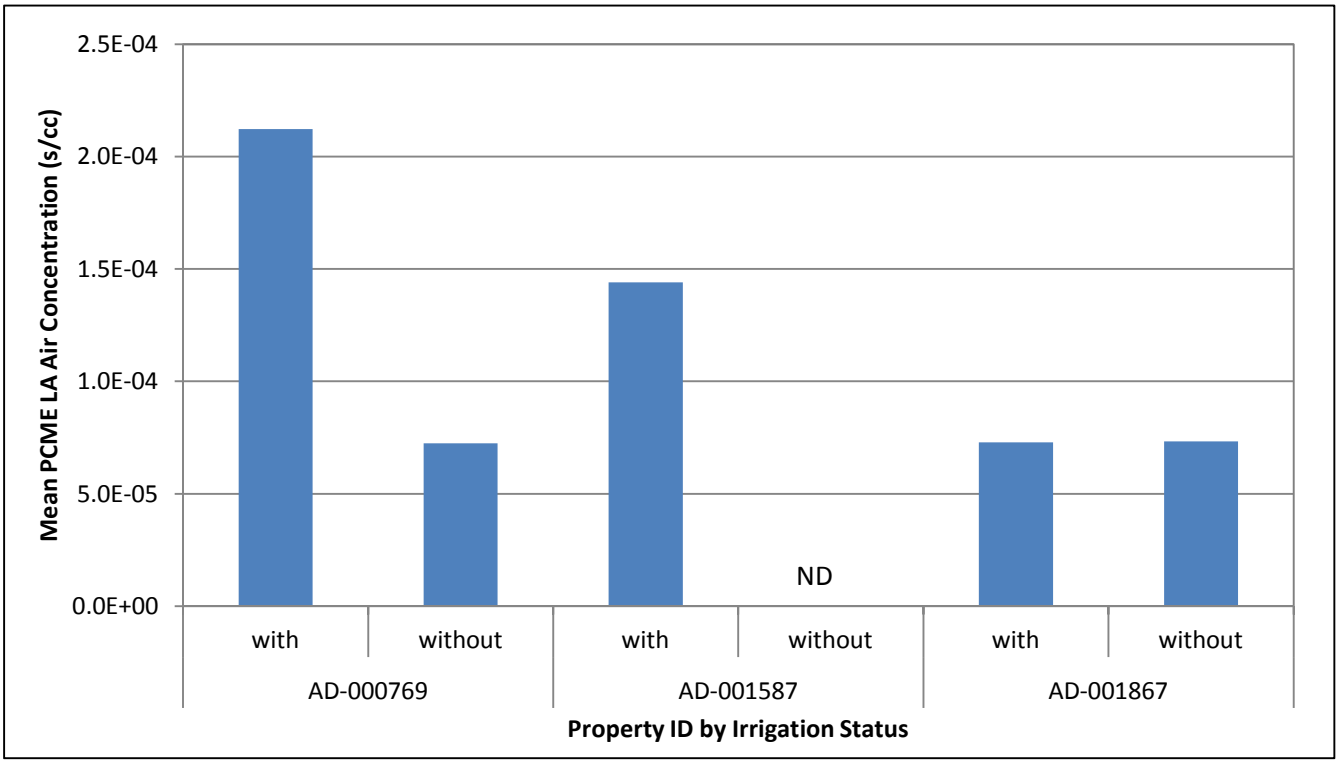
FIGURE 6-1
MEAN ABS AIR CONCENTRATIONS AFTER MOWING WITH AND WITHOUT IRRIGATION FOR SCENARIO 3



Notes:

PCME - phase contrast microscopy-equivalent

LA - Libby amphibole

s/cc - structures per cubic centimeter

ND - non-detect

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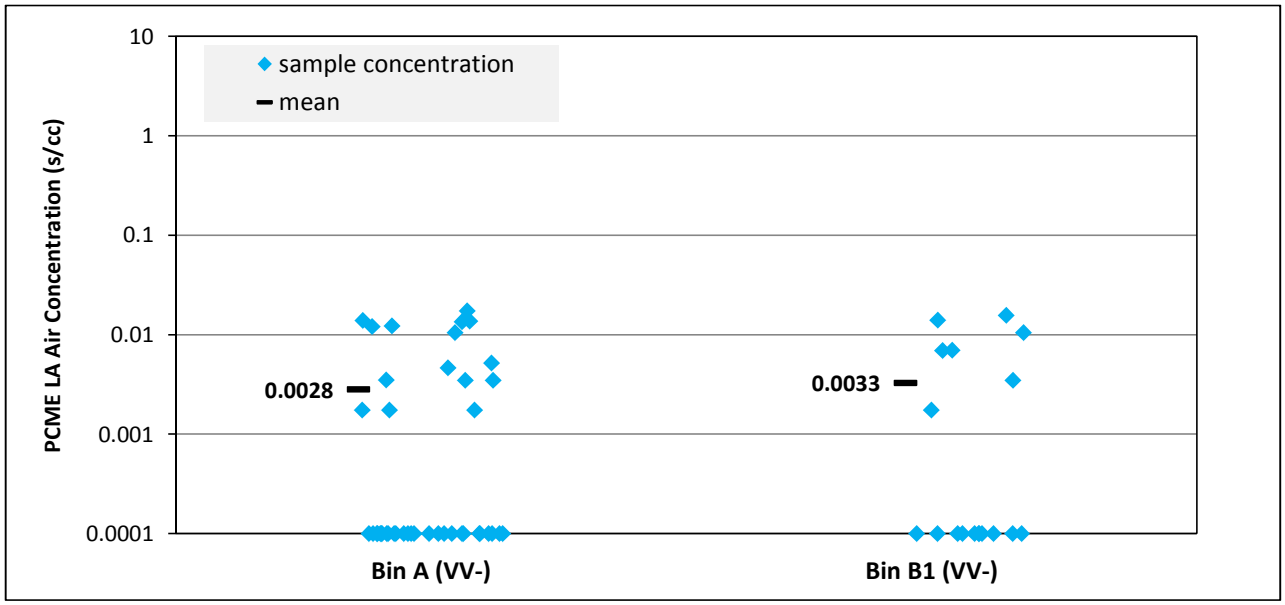
FIGURE 8-1

CORRELATION OF ABS AIR CONCENTRATIONS TO SOIL PLM-VE RESULTS FOR SCENARIO 5



Notes:

Visible vermiculite (VV) was not observed in any sample.

Non-detects are plotted at 0.0001 s/cc.

ABS - activity based sampling

PLM-VE - polarized light microscopy visual estimation

PCME - phase contrast light microscopy

LA - Libby Amphibole

s/cc - structures per cubic centimeter

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APPENDICES

(available electronically upon request)

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Libby, Montana

ATTACHMENT 1
Detailed Sample Information and Analysis Results

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ATTACHMENT 1A. Description of Sampling Events

Scenario	Scenario Description	Activity
1	Comparison of ABS Scripts	Digging (high intensity)
		Mowing (high intensity)
		Raking (high intensity)
		Digging/mowing/raking (low intensity)
2	Replication of 2010 ABS Study	Digging/mowing/raking (low intensity)
3	Mowing Before and After Irrigation	Without irrigation
		With irrigation
4	Curb-to-Curb Properties	Digging/mowing/raking
5	Limited-Use Areas	ATV Rider 1
		ATV Rider 2

Data Restrictions:

Only field samples are included; field quality control (QC) samples (e.g., field duplicates) are excluded.
Only laboratory "Not QC" analyses are included; laboratory QC analyses (e.g., laboratory duplicates) are excluded.
Results are presented for Libby amphibole (LA) only; chrysotile and other amphibole results are excluded.

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ATTACHMENT 1B. Detailed Results of Air Samples Collected During the 2011 Residential Activity-Based Sampling Investigation

ABS Information				Sample Information					Analysis Information										Results	
Property ID	Scenario	Event	Activity	Sample ID	Matrix	Sample Date	Sample Type	Volume Collected (L)	Analysis Method	Laboratory	Lab QC Type	Prep Method	Prep Date	Analysis Date	EFA (mm^2)	GO Size (mm^2)	GOs Counted	Sensitivity $(cc)^{-1}$	N LA Structures PCME	LA Air Conc. (s/cc) PCME
AD-000013	1	1	Digging/mowing/raking (low intensity)	EX-20126	Air	7/19/2011	Field Sample	322	TEM-ISO	EMSL04	NOT QC	Direct	10/28/2011	11/21/2011	385	0.0132	420	2.16E-04	4	8.6E-04
AD-000013	1	1	Raking (high intensity)	EX-20128	Air	7/19/2011	Field Sample	652	TEM-ISO	EMSL27	NOT QC	Direct	8/15/2011	8/23/2011	385	0.013	208	2.18E-04	0	0
AD-000013	1	1	Digging (high intensity)	EX-20129	Air	7/19/2011	Field Sample	614	TEM-ISO	EMSL27	NOT QC	Direct	8/15/2011	8/23/2011	385	0.013	220	2.19E-04	0	0
AD-000013	1	1	Mowing (high intensity)	EX-20132	Air	7/19/2011	Field Sample	236	TEM-ISO	EMSL27	NOT QC	Direct	8/15/2011	8/22/2011	385	0.013	575	2.18E-04	12	2.6E-03
AD-000013	1	2	Digging/mowing/raking (low intensity)	EX-20298	Air	8/2/2011	Field Sample	345	TEM-ISO	EMSL22	NOT QC	Direct	9/22/2011	11/14/2011	385	0.0129	394	2.20E-04	3	6.6E-04
AD-000013	1	2	Raking (high intensity)	EX-20299	Air	8/2/2011	Field Sample	688	TEM-ISO	RESI	NOT QC	Indirect	9/8/2011	10/4/2011	346	0.011	589	3.10E-04	24	7.5E-03
AD-000013	1	2	Digging (high intensity)	EX-20342	Air	8/2/2011	Field Sample	656	TEM-ISO	RESI	NOT QC	Direct	9/8/2011	10/4/2011	385	0.011	251	2.13E-04	1	2.1E-04
AD-000013	1	2	Mowing (high intensity)	EX-20344	Air	8/2/2011	Field Sample	650	TEM-ISO	RESI	NOT QC	Indirect	9/8/2011	10/4/2011	346	0.011	156	1.55E-03	26	4.0E-02
AD-000025	2	1	Digging/mowing/raking (low intensity)	EX-20036	Air	7/15/2011	Field Sample	352	TEM-ISO	EMSL19	NOT QC	Direct	8/19/2011	8/31/2011	385	0.0064	780	2.19E-04	0	0
AD-000025	2	2	Digging/mowing/raking (low intensity)	EX-20169	Air	7/27/2011	Field Sample	347	TEM-ISO	EMSL27	NOT QC	Direct	11/14/2011	11/17/2011	385	0.013	400	2.13E-04	0	0
AD-000025	2	3	Digging/mowing/raking (low intensity)	EX-20377	Air	8/6/2011	Field Sample	324	TEM-ISO	EMSL27	NOT QC	Direct	12/6/2011	12/7/2011	385	0.013	420	2.18E-04	0	0
AD-000065	1	1	Digging/mowing/raking (low intensity)	EX-20156	Air	7/23/2011	Field Sample	344	TEM-ISO	EMSL04	NOT QC	Direct	10/28/2011	11/28/2011	385	0.0132	386	2.20E-04	1	2.2E-04
AD-000065	1	1	Raking (high intensity)	EX-20157	Air	7/23/2011	Field Sample	671	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/23/2011	9/12/2011	346	0.0099	316	2.20E-04	3	6.6E-04
AD-000065	1	1	Digging (high intensity)	EX-20159	Air	7/23/2011	Field Sample	663	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/23/2011	9/13/2011	346	0.0099	959	2.20E-04	2	4.4E-04
AD-000065	1	1	Mowing (high intensity)	EX-20161	Air	7/23/2011	Field Sample	642	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/23/2011	9/14/2011	346	0.0099	1820	2.99E-04	26	7.8E-03
AD-000065	1	2	Digging/mowing/raking (low intensity)	EX-20403	Air	8/4/2011	Field Sample	336	TEM-ISO	EMSL27	NOT QC	Direct	1/6/2012	1/11/2012	385	0.013	445	1.98E-04	1	2.0E-04
AD-000065	1	2	Raking (high intensity)	EX-20405	Air	8/4/2011	Field Sample	254	TEM-ISO	EMSL27	NOT QC	Direct	1/6/2012	1/11/2012	385	0.013	585	1.99E-04	0	0
AD-000065	1	2	Digging (high intensity)	EX-20407	Air	8/4/2011	Field Sample	632	TEM-ISO	EMSL27	NOT QC	Direct	1/6/2012	1/16/2012	385	0.013	215	2.18E-04	0	0
AD-000065	1	2	Mowing (high intensity)	EX-20410	Air	8/4/2011	Field Sample	273	TEM-ISO	EMSL27	NOT QC	Direct	1/6/2012	1/16/2012	385	0.013	495	2.19E-04	0	0
AD-000146	1	1	Raking (high intensity)	EX-20077	Air	7/15/2011	Field Sample	250	TEM-ISO	Hygeia	NOT QC	Direct	8/17/2011	8/24/2011	385	0.0099	708	2.20E-04	0	0
AD-000146	1	1	Digging/mowing/raking (low intensity)	EX-20079	Air	7/15/2011	Field Sample	331	TEM-ISO	EMSL04	NOT QC	Direct	10/28/2011	11/2/2011	385	0.0132	401	2.20E-04	0	0
AD-000146	1	1	Digging (high intensity)	EX-20084	Air	7/15/2011	Field Sample	684	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/22/2011	8/31/2011	346	0.0099	930	2.20E-04	2	4.4E-04
AD-000146	1	1	Mowing (high intensity)	EX-20086	Air	7/15/2011	Field Sample	662	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/22/2011	9/1/2011	346	0.0099	960	2.20E-04	1	2.2E-04
AD-000146	1	2	Digging/mowing/raking (low intensity)	EX-20246	Air	7/29/2011	Field Sample	326	TEM-ISO	EMSL22	NOT QC	Direct	9/22/2011	9/23/2011	385	0.0129	417	2.20E-04	2	4.4E-04
AD-000146	1	2	Raking (high intensity)	EX-20247	Air	7/29/2011	Field Sample	656	TEM-ISO	EMSL27	NOT QC	Direct	8/22/2011	10/18/2011	385	0.013	206	2.19E-04	0	0
AD-000146	1	2	Digging (high intensity)	EX-20250	Air	7/29/2011	Field Sample	248	TEM-ISO	EMSL27	NOT QC	Direct	8/22/2011	11/11/2011	385	0.013	545	2.19E-04	0	0
AD-000146	1	2	Mowing (high intensity)	EX-20252	Air	7/29/2011	Field Sample	248	TEM-ISO	EMSL27	NOT QC	Direct	8/22/2011	12/5/2011	385	0.013	545	2.19E-04	1	2.2E-04
AD-000146	2	1	Digging/mowing/raking (low intensity)	EX-20516	Air	8/16/2011	Field Sample	329	TEM-ISO	EMSL27	NOT QC	Direct	12/7/2011	12/13/2011	385	0.013	410	2.20E-04	0	0
AD-000146	2	2	Digging/mowing/raking (low intensity)	EX-20626	Air	8/30/2011	Field Sample	311	TEM-ISO	EMSL27	NOT QC	Direct	12/7/2011	1/4/2012	385	0.013	435	2.19E-04	0	0
AD-000146	2	3	Digging/mowing/raking (low intensity)	EX-20715	Air	9/13/2011	Field Sample	136	TEM-ISO	EMSL27	NOT QC	Direct	12/7/2011	1/5/2012	385	0.013	990	2.20E-04	0	0
AD-000157	5	1	ATV Rider 1	EX-30022	Air	8/25/2011	Field Sample	136	TEM-ISO	EMSL04	NOT QC	Direct	12/22/2011	1/12/2012	385	0.0132	123	1.74E-03	0	0
AD-000157	5	1	ATV Rider 2	EX-30024	Air	8/25/2011	Field Sample	326	TEM-ISO	EMSL04	NOT QC	Direct	12/22/2011	1/12/2012	385	0.0132	52	1.72E-03	0	0
AD-000157	5	2	ATV Rider 1	EX-30028	Air	8/25/2011	Field Sample	304	TEM-ISO	EMSL04	NOT QC	Direct	12/22/2011	1/12/2012	385	0.0132	55	1.74E-03	0	0
AD-000157	5	2	ATV Rider 2	EX-30031	Air	8/25/2011	Field Sample	136	TEM-ISO	EMSL04	NOT QC	Direct	1/16/2012	1/18/2012	385	0.0132	123	1.74E-03	2	3.5E-03
AD-000157	5	3	ATV Rider 1	EX-30034	Air	8/25/2011	Field Sample	323	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/17/2012	1/18/2012	360	0.013	490	1.75E-03	0	0
AD-000157	5	3	ATV Rider 2	EX-30036	Air	8/25/2011	Field Sample	332	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/17/2012	1/18/2012	360	0.013	480	1.74E-03	0	0
AD-000258	2	1	Digging/mowing/raking (low intensity)	EX-20030	Air	7/15/2011	Field Sample	352	TEM-ISO	EMSL19	NOT QC	Direct	8/19/2011	8/31/2011	385	0.0064	779	2.19E-04	0	0
AD-000258	2	2	Digging/mowing/raking (low intensity)	EX-20166	Air	7/26/2011	Field Sample	326	TEM-ISO	EMSL19	NOT QC	Direct	8/19/2011	9/7/2011	385	0.0064	845	2.18E-04	2	4.4E-04
AD-000258	2	3	Digging/mowing/raking (low intensity)	EX-20373	Air	8/6/2011	Field Sample	327	TEM-ISO	EMSL27	NOT QC	Direct	12/6/2011	12/7/2011	385	0.013	415	2.18E-04	0	0
AD-000262	2	1	Digging/mowing/raking (low intensity)	EX-20065	Air	7/14/2011	Field Sample	341	TEM-ISO	EMSL19	NOT QC	Direct	8/19/2011	8/31/2011	385	0.0064	809	2.18E-04	0	0
AD-000316	1	1	Digging/mowing/raking (low intensity)	EX-20120	Air	7/20/2011	Field Sample	349	TEM-ISO	EMSL04	NOT QC	Direct	10/28/2011	11/14/2011	385	0.0132	380	2.20E-04	4	8.8E-04
AD-000316	1	1	Raking (high intensity)	EX-20182	Air	7/20/2011	Field Sample	656	TEM-ISO	EMSL27	NOT QC	Direct	8/15/2011	8/22/2011	385	0.013	216	2.09E-04	0	0
AD-000316	1	1	Digging (high intensity)	EX-20184	Air	7/20/2011	Field Sample	656	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/23/2011	9/14/2011	346	0.0099	969	2.20E-04	3	6.6E-04
AD-000316	1	1	Mowing (high intensity)	EX-20185	Air	7/20/2011	Field Sample	251	TEM-ISO	EMSL27	NOT QC	Direct	8/22/2011	8/24/2011	385	0.013	555	2.13E-04	0	0
AD-000316	1	2	Digging/mowing/raking (low intensity)	EX-20323	Air	8/10/2011	Field Sample	316	TEM-ISO	EMSL27	NOT QC	Direct	1/10/2012	1/10/2012	385	0.013	500	1.87E-04	0	0
AD-000316	1	2	Raking (high intensity)	EX-20325	Air	8/10/2011	Field Sample	248	TEM-ISO	EMSL04	NOT QC	Direct	12/14/2011	1/3/2012	385	0.0132	535	2.20E-04	1	2.2E-04
AD-000316	1	2	Digging (high intensity)	EX-20326	Air	8/10/2011	Field Sample	666	TEM-ISO	EMSL04	NOT QC	Direct	12/27/2011	12/28/2011	385	0.0132	200	2.19E-04	0	0
AD-000316	1	2	Mowing (high intensity)	EX-20329	Air	8/10/2011	Field Sample	650	TEM-ISO	EMSL04	NOT QC	Direct	12/14/2011	12/29/2011	385	0.0132	204	2.20E-04	3	6.6E-04
AD-000353	4	1	Digging/mowing/raking	EX-20208	Air	7/23/2011	Field Sample	295	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/12/2011	8/17/2011	346	0.0099	718	2.20E-04	3	6.6E-04
AD-000353	4	2	Digging/mowing/raking	EX-20356	Air	8/4/2011	Field Sample	246	TEM-ISO	EMSL27	NOT QC	Direct	9/1/2011	9/1/2011	385	0.013	550	2.19E-04	0	0

ATTACHMENT 1B. Detailed Results of Air Samples Collected During the 2011 Residential Activity-Based Sampling Investigation

ABS Information				Sample Information					Analysis Information										Results	
Property ID	Scenario	Event	Activity	Sample ID	Matrix	Sample Date	Sample Type	Volume Collected (L)	Analysis Method	Laboratory	Lab QC Type	Prep Method	Prep Date	Analysis Date	EFA (mm^2)	GO Size (mm^2)	GOs Counted	Sensitivity $(cc)^{-1}$	N LA Structures PCME	LA Air Conc. (s/cc) PCME
AD-000353	4	3	Digging/mowing/raking	EX-20504	Air	8/15/2011	Field Sample	271	TEM-ISO	EMSL27	NOT QC	Direct	9/1/2011	9/2/2011	385	0.013	550	1.99E-04	0	0
AD-000414	4	1	Digging/mowing/raking	EX-20201	Air	7/23/2011	Field Sample	752	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/12/2011	8/17/2011	346	0.0099	406	4.58E-04	25	1.1E-02
AD-000414	4	2	Digging/mowing/raking	EX-20348	Air	8/3/2011	Field Sample	504	TEM-ISO	EMSL27	NOT QC	Direct	9/1/2011	9/1/2011	385	0.013	270	2.18E-04	0	0
AD-000414	4	3	Digging/mowing/raking	EX-20469	Air	8/12/2011	Field Sample	435	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	9/1/2011	9/2/2011	360	0.013	1270	2.01E-04	0	0
AD-000444	2	1	Digging/mowing/raking (low intensity)	EX-20005	Air	7/12/2011	Field Sample	374	TEM-ISO	EMSL19	NOT QC	Direct	8/19/2011	8/30/2011	385	0.0064	735	2.19E-04	2	4.4E-04
AD-000444	2	2	Digging/mowing/raking (low intensity)	EX-20211	Air	7/26/2011	Field Sample	328	TEM-ISO	EMSL19	NOT QC	Direct	8/19/2011	9/7/2011	385	0.0064	848	2.16E-04	4	8.7E-04
AD-000444	2	3	Digging/mowing/raking (low intensity)	EX-20369	Air	8/5/2011	Field Sample	345	TEM-ISO	EMSL27	NOT QC	Direct	12/6/2011	12/6/2011	385	0.013	391	2.20E-04	0	0
AD-000662	1	1	Digging/mowing/raking (low intensity)	EX-20055	Air	7/18/2011	Field Sample	323	TEM-ISO	EMSL04	NOT QC	Direct	10/28/2011	11/1/2011	385	0.0132	138	6.54E-04	21	1.4E-02
AD-000662	1	1	Raking (high intensity)	EX-20057	Air	7/18/2011	Field Sample	584	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/22/2011	8/30/2011	346	0.0099	1089	2.20E-04	13	2.9E-03
AD-000662	1	1	Digging (high intensity)	EX-20058	Air	7/18/2011	Field Sample	600	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/22/2011	8/30/2011	346	0.0099	72	8.09E-03	25	2.0E-01
AD-000662	1	1	Mowing (high intensity)	EX-20060	Air	7/18/2011	Field Sample	624	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/22/2011	8/31/2011	346	0.0099	57	3.93E-03	25	9.8E-02
AD-000662	1	2	Digging/mowing/raking (low intensity)	EX-20288	Air	8/1/2011	Field Sample	332	TEM-ISO	EMSL22	NOT QC	Direct	9/22/2011	10/18/2011	385	0.0129	409	2.20E-04	10	2.2E-03
AD-000662	1	2	Raking (high intensity)	EX-20289	Air	8/1/2011	Field Sample	660	TEM-ISO	EMSL27	NOT QC	Direct	8/22/2011	11/15/2011	385	0.013	205	2.19E-04	4	8.8E-04
AD-000662	1	2	Digging (high intensity)	EX-20292	Air	8/1/2011	Field Sample	248	TEM-ISO	EMSL27	NOT QC	Direct	8/22/2011	11/17/2011	385	0.013	323	3.70E-04	26	9.6E-03
AD-000662	1	2	Mowing (high intensity)	EX-20294	Air	8/1/2011	Field Sample	248	TEM-ISO	EMSL27	NOT QC	Direct	8/22/2011	11/28/2011	385	0.013	546	2.19E-04	15	3.3E-03
AD-000769	3	1	Without irrigation	EX-20070	Air	7/14/2011	Field Sample	273	TEM-ISO	Hygeia	NOT QC	Direct	8/10/2011	8/11/2011	385	0.0099	753	1.89E-04	0	0
AD-000769	3	1	With irrigation	EX-20238	Air	7/28/2011	Field Sample	250	TEM-ISO	EMSL27	NOT QC	Direct	11/14/2011	12/15/2011	385	0.013	558	2.12E-04	3	6.4E-04
AD-000769	3	2	Without irrigation	EX-20492	Air	8/11/2011	Field Sample	282	TEM-ISO	EMSL27	NOT QC	Direct	12/6/2011	12/13/2011	385	0.013	480	2.19E-04	0	0
AD-000769	3	2	With irrigation	EX-20576	Air	8/25/2011	Field Sample	211	TEM-ISO	EMSL27	NOT QC	Direct	12/6/2011	12/28/2011	385	0.013	700	2.01E-04	0	0
AD-000769	3	3	Without irrigation	EX-20702	Air	9/10/2011	Field Sample	207	TEM-ISO	EMSL27	NOT QC	Direct	12/6/2011	3/14/2012	385	0.013	659	2.17E-04	1	2.2E-04
AD-000769	3	3	With irrigation	EX-20728	Air	9/23/2011	Field Sample	277	TEM-ISO	EMSL19	NOT QC	Direct	11/8/2011	12/13/2011	385	0.013	490	2.18E-04	0	0
AD-001587	3	1	Without irrigation	EX-20017	Air	7/14/2011	Field Sample	284	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/12/2011	8/16/2011	346	0.0099	825	1.99E-04	0	0
AD-001587	3	1	With irrigation	EX-20227	Air	7/28/2011	Field Sample	476	TEM-ISO	EMSL27	NOT QC	Direct	11/14/2011	12/12/2011	385	0.013	288	2.16E-04	2	4.3E-04
AD-001587	3	2	Without irrigation	EX-20499	Air	8/11/2011	Field Sample	335	TEM-ISO	EMSL27	NOT QC	Direct	12/6/2011	12/28/2011	385	0.013	407	2.17E-04	0	0
AD-001587	3	2	With irrigation	EX-20618	Air	8/26/2011	Field Sample	289	TEM-ISO	EMSL27	NOT QC	Direct	12/6/2011	1/3/2012	385	0.013	470	2.18E-04	0	0
AD-001587	3	3	Without irrigation	EX-20634	Air	9/10/2011	Field Sample	215	TEM-ISO	EMSL27	NOT QC	Direct	12/6/2011	1/5/2012	385	0.013	630	2.19E-04	0	0
AD-001587	3	3	With irrigation	EX-20719	Air	9/23/2011	Field Sample	432	TEM-ISO	EMSL19	NOT QC	Direct	11/8/2011	11/22/2011	385	0.0064	638	2.18E-04	0	0
AD-001713	4	1	Digging/mowing/raking	EX-20215	Air	7/27/2011	Field Sample	290	TEM-ISO	EMSL27	NOT QC	Direct	11/16/2011	12/6/2011	385	0.013	465	2.20E-04	1	2.2E-04
AD-001713	4	2	Digging/mowing/raking	EX-20360	Air	8/4/2011	Field Sample	324	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/5/2012	1/17/2012	360	0.013	1542	1.11E-03	11	1.2E-02
AD-001713	4	3	Digging/mowing/raking	EX-20509	Air	8/15/2011	Field Sample	112	TEM-ISO	EMSL04	NOT QC	Direct	1/20/2014	1/20/2014	385	0.0132	852	3.06E-04	3	9.2E-04
AD-001713	4	3	Digging/mowing/raking	EX-20509	Air	8/15/2011	Field Sample	112	TEM-ISO	EMSL04	NOT QC	Direct	12/8/2011	12/14/2011	385	0.0132	332	7.84E-04	2	1.6E-03
AD-001722	4	1	Digging/mowing/raking	EX-20218	Air	7/27/2011	Field Sample	301	TEM-ISO	EMSL27	NOT QC	Direct	11/16/2011	12/6/2011	385	0.013	451	2.18E-04	0	0
AD-001722	4	2	Digging/mowing/raking	EX-20422	Air	8/6/2011	Field Sample	263	TEM-ISO	EMSL27	NOT QC	Direct	1/3/2012	1/13/2012	385	0.013	734	1.53E-04	3	4.6E-04
AD-001722	4	3	Digging/mowing/raking	EX-20512	Air	8/16/2011	Field Sample	283	TEM-ISO	EMSL04	NOT QC	Direct	12/8/2011	12/12/2011	385	0.0132	470	2.19E-04	0	0
AD-001731	1	1	Digging/mowing/raking (low intensity)	EX-20043	Air	7/16/2011	Field Sample	315	TEM-ISO	EMSL04	NOT QC	Direct	10/28/2011	10/31/2011	385	0.0132	67	1.38E-03	22	3.0E-02
AD-001731	1	1	Raking (high intensity)	EX-20044	Air	7/16/2011	Field Sample	647	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/22/2011	8/25/2011	346	0.0099	61	3.54E-03	25	8.9E-02
AD-001731	1	1	Digging (high intensity)	EX-20048	Air	7/16/2011	Field Sample	690	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/22/2011	8/29/2011	346	0.0099	101	1.00E-02	26	2.6E-01
AD-001731	1	1	Mowing (high intensity)	EX-20050	Air	7/16/2011	Field Sample	623	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/22/2011	8/29/2011	346	0.0099	71	1.58E-02	25	4.0E-01
AD-001731	1	2	Digging/mowing/raking (low intensity)	EX-20276	Air	7/29/2011	Field Sample	329	TEM-ISO	EMSL22	NOT QC	Direct	9/22/2011	9/30/2011	385	0.0131	97	9.21E-04	24	2.2E-02
AD-001731	1	2	Raking (high intensity)	EX-20278	Air	7/29/2011	Field Sample	666	TEM-ISO	EMSL27	NOT QC	Direct	8/22/2011	11/14/2011	385	0.013	151	2.94E-04	25	7.4E-03
AD-001731	1	2	Digging (high intensity)	EX-20280	Air	7/29/2011	Field Sample	679	TEM-ISO	EMSL27	NOT QC	Direct	8/22/2011	11/16/2011	385	0.013	200	2.18E-04	5	1.1E-03
AD-001731	1	2	Mowing (high intensity)	EX-20282	Air	7/29/2011	Field Sample	249	TEM-ISO	EMSL27	NOT QC	Direct	8/22/2011	11/16/2011	385	0.013	163	7.30E-04	26	1.9E-02
AD-001731	2	1	Digging/mowing/raking (low intensity)	EX-20564	Air	8/18/2011	Field Sample	328	TEM-ISO	EMSL27	NOT QC	Direct	12/7/2011	12/14/2011	385	0.013	252	3.58E-04	25	9.0E-03
AD-001731	2	2	Digging/mowing/raking (low intensity)	EX-20613	Air	8/29/2011	Field Sample	330	TEM-ISO	EMSL27	NOT QC	Direct	12/7/2011	1/4/2012	385	0.013	219	4.10E-04	25	1.0E-02
AD-001731	2	3	Digging/mowing/raking (low intensity)	EX-20707	Air	9/13/2011	Field Sample	143	TEM-ISO	EMSL27	NOT QC	Direct	12/7/2011	1/5/2012	385	0.013	117	1.77E-03	25	4.4E-02
AD-001732	2	1	Digging/mowing/raking (low intensity)	EX-20145	Air	7/21/2011	Field Sample	368	TEM-ISO	EMSL19	NOT QC	Direct	8/19/2011	9/6/2011	385	0.0064	790	2.07E-04	4	8.3E-04
AD-001732	2	2	Digging/mowing/raking (low intensity)	EX-20352	Air	8/3/2011	Field Sample	341	TEM-ISO	EMSL27	NOT QC	Direct	12/6/2011	12/6/2011	385	0.013	395	2.20E-04	0	0
AD-001732	2	3	Digging/mowing/raking (low intensity)	EX-20477	Air	8/12/2011	Field Sample	325	TEM-ISO	EMSL27	NOT QC	Direct	12/7/2011	12/13/2011	385	0.013	415	2.20E-04	0	0
AD-001853	2	1	Digging/mowing/raking (low intensity)	EX-20014	Air	7/13/2011	Field Sample	332	TEM-ISO	EMSL19	NOT QC	Direct	8/19/2011	8/30/2011	385	0.0064	825	2.20E-04	0	0
AD-001853	2	2	Digging/mowing/raking (low intensity)	EX-20177	Air	7/27/2011	Field Sample	330	TEM-ISO	EMSL27	NOT QC	Direct	11/4/2011	12/9/2011	385	0.013	415	2.16E-04	0	0

ATTACHMENT 1B. Detailed Results of Air Samples Collected During the 2011 Residential Activity-Based Sampling Investigation

ABS Information				Sample Information					Analysis Information										Results	
Property ID	Scenario	Event	Activity	Sample ID	Matrix	Sample Date	Sample Type	Volume Collected (L)	Analysis Method	Laboratory	Lab QC Type	Prep Method	Prep Date	Analysis Date	EFA (mm^2)	GO Size (mm^2)	GOs Counted	Sensitivity $(cc)^{-1}$	N LA Structures PCME	LA Air Conc. (s/cc) PCME
AD-001853	2	3	Digging/mowing/raking (low intensity)	EX-20365	Air	8/5/2011	Field Sample	342	TEM-ISO	EMSL27	NOT QC	Direct	12/6/2011	12/6/2011	385	0.013	395	2.19E-04	0	0
AD-001855	5	1	ATV Rider 2	EX-30004	Air	8/24/2011	Field Sample	133	TEM-ISO	EMSL04	NOT QC	Direct	1/16/2012	1/17/2012	385	0.0132	126	1.74E-03	0	0
AD-001855	5	1	ATV Rider 1	EX-30007	Air	8/24/2011	Field Sample	314	TEM-ISO	EMSL04	NOT QC	Indirect - Ashed	1/19/2012	1/20/2012	364.9	0.0132	806	1.75E-03	0	0
AD-001855	5	1	ATV Rider 1	EX-30200	Air	9/14/2011	Field Sample	326	TEM-ISO	EMSL04	NOT QC	Indirect - Ashed	1/14/2012	1/16/2012	365	0.0132	388	1.75E-03	1	1.7E-03
AD-001855	5	1	ATV Rider 2	EX-30263	Air	9/14/2011	Field Sample	136	TEM-ISO	EMSL04	NOT QC	Direct	1/12/2012	1/13/2012	385	0.0132	123	1.74E-03	0	0
AD-001855	5	2	ATV Rider 1	EX-30011	Air	8/24/2011	Field Sample	320	TEM-ISO	EMSL04	NOT QC	Indirect - Ashed	1/19/2012	1/25/2012	364.9	0.0132	791	1.75E-03	0	0
AD-001855	5	2	ATV Rider 2	EX-30012	Air	8/24/2011	Field Sample	136	TEM-ISO	EMSL04	NOT QC	Direct	1/16/2012	1/17/2012	385	0.0132	123	1.74E-03	0	0
AD-001855	5	2	ATV Rider 1	EX-30266	Air	9/14/2011	Field Sample	314	TEM-ISO	EMSL04	NOT QC	Indirect - Ashed	1/19/2012	1/19/2012	365	0.0132	806	1.75E-03	1	1.7E-03
AD-001855	5	2	ATV Rider 2	EX-30268	Air	9/14/2011	Field Sample	320	TEM-ISO	EMSL04	NOT QC	Indirect - Ashed	1/14/2012	1/19/2012	365	0.0132	1317	1.75E-03	2	3.5E-03
AD-001855	5	3	ATV Rider 2	EX-30016	Air	8/24/2011	Field Sample	136	TEM-ISO	EMSL04	NOT QC	Direct	12/22/2011	1/13/2012	385	0.0132	123	1.74E-03	0	0
AD-001855	5	3	ATV Rider 1	EX-30019	Air	8/24/2011	Field Sample	314	TEM-ISO	EMSL04	NOT QC	Indirect - Ashed	1/19/2012	1/25/2012	364.9	0.0132	1516	4.65E-03	1	4.6E-03
AD-001855	5	3	ATV Rider 1	EX-30272	Air	9/14/2011	Field Sample	311	TEM-ISO	EMSL04	NOT QC	Indirect - Ashed	1/19/2012	1/23/2012	365	0.0132	407	1.75E-03	1	1.7E-03
AD-001855	5	3	ATV Rider 2	EX-30274	Air	9/14/2011	Field Sample	323	TEM-ISO	EMSL04	NOT QC	Indirect - Ashed	1/19/2012	1/22/2012	364.9	0.0132	392	1.75E-03	0	0
AD-001864	1	1	Digging/mowing/raking (low intensity)	EX-20136	Air	7/20/2011	Field Sample	325	TEM-ISO	EMSL04	NOT QC	Indirect - Ashed	12/3/2011	12/5/2011	364.9	0.0132	1516	2.24E-04	2	4.5E-04
AD-001864	1	1	Raking (high intensity)	EX-20137	Air	7/20/2011	Field Sample	647	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/23/2011	9/7/2011	346	0.0099	983	2.20E-04	19	4.2E-03
AD-001864	1	1	Digging (high intensity)	EX-20139	Air	7/20/2011	Field Sample	648	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/23/2011	9/9/2011	346	0.0099	981	2.20E-04	13	2.9E-03
AD-001864	1	1	Mowing (high intensity)	EX-20141	Air	7/20/2011	Field Sample	665	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/23/2011	9/9/2011	346	0.0099	2021	2.60E-03	5	1.3E-02
AD-001864	1	2	Digging/mowing/raking (low intensity)	EX-20333	Air	8/3/2011	Field Sample	315	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/6/2012	1/11/2012	360	0.013	1540	5.71E-04	0	0
AD-001864	1	2	Raking (high intensity)	EX-20334	Air	8/3/2011	Field Sample	632	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/6/2012	1/11/2012	360	0.013	1540	2.85E-04	0	0
AD-001864	1	2	Digging (high intensity)	EX-20337	Air	8/3/2011	Field Sample	648	TEM-ISO	EMSL27	NOT QC	Direct	1/5/2012	1/10/2012	385	0.013	230	1.99E-04	0	0
AD-001864	1	2	Mowing (high intensity)	EX-20339	Air	8/3/2011	Field Sample	616	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/6/2012	1/12/2012	360	0.013	1540	2.92E-03	2	5.8E-03
AD-001867	3	1	Without irrigation	EX-20024	Air	7/14/2011	Field Sample	402	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/12/2011	8/16/2011	346	0.0099	527	2.20E-04	1	2.2E-04
AD-001867	3	1	With irrigation	EX-20232	Air	7/28/2011	Field Sample	312	TEM-ISO	EMSL27	NOT QC	Direct	11/14/2011	12/14/2011	385	0.013	434	2.19E-04	1	2.2E-04
AD-001867	3	2	Without irrigation	EX-20496	Air	8/11/2011	Field Sample	313	TEM-ISO	EMSL27	NOT QC	Direct	12/6/2011	12/13/2011	385	0.013	435	2.18E-04	0	0
AD-001867	3	2	With irrigation	EX-20630	Air	8/26/2011	Field Sample	154	TEM-ISO	EMSL27	NOT QC	Direct	12/6/2011	1/3/2012	385	0.013	880	2.19E-04	0	0
AD-001867	3	3	Without irrigation	EX-20637	Air	9/10/2011	Field Sample	162	TEM-ISO	EMSL27	NOT QC	Direct	12/6/2011	1/5/2012	385	0.013	857	2.13E-04	0	0
AD-001867	3	3	With irrigation	EX-20723	Air	9/23/2011	Field Sample	164	TEM-ISO	EMSL19	NOT QC	Direct	11/8/2011	11/22/2011	385	0.0064	1670	2.20E-04	0	0
AD-001868	1	1	Digging/mowing/raking (low intensity)	EX-20110	Air	7/19/2011	Field Sample	325	TEM-ISO	EMSL04	NOT QC	Direct	10/28/2011	11/14/2011	385	0.0132	409	2.19E-04	2	4.4E-04
AD-001868	1	1	Raking (high intensity)	EX-20112	Air	7/19/2011	Field Sample	642	TEM-ISO	EMSL27	NOT QC	Direct	8/15/2011	8/16/2011	385	0.013	420	1.10E-04	1	1.1E-04
AD-001868	1	1	Digging (high intensity)	EX-20114	Air	7/19/2011	Field Sample	627	TEM-ISO	EMSL27	NOT QC	Direct	8/15/2011	8/23/2011	385	0.013	210	2.25E-04	0	0
AD-001868	1	1	Mowing (high intensity)	EX-20115	Air	7/19/2011	Field Sample	228	TEM-ISO	EMSL27	NOT QC	Direct	8/15/2011	8/26/2011	385	0.013	600	2.16E-04	1	2.2E-04
AD-001868	1	2	Digging/mowing/raking (low intensity)	EX-20313	Air	8/2/2011	Field Sample	342	TEM-ISO	EMSL22	NOT QC	Direct	9/22/2011	11/22/2011	385	0.0129	397	2.20E-04	8	1.8E-03
AD-001868	1	2	Raking (high intensity)	EX-20314	Air	8/2/2011	Field Sample	674	TEM-ISO	RESI	NOT QC	Direct	11/29/2011	12/1/2011	385	0.01	133	4.29E-04	26	1.1E-02
AD-001868	1	2	Digging (high intensity)	EX-20317	Air	8/2/2011	Field Sample	638	TEM-ISO	RESI	NOT QC	Indirect - Ashed	9/8/2011	10/1/2011	201	0.011	415	6.90E-04	25	1.7E-02
AD-001868	1	2	Mowing (high intensity)	EX-20319	Air	8/2/2011	Field Sample	632	TEM-ISO	RESI	NOT QC	Indirect - Ashed	9/8/2011	10/4/2011	201	0.011	85	3.40E-03	25	8.5E-02
AD-001888	1	1	Digging/mowing/raking (low intensity)	EX-20190	Air	7/21/2011	Field Sample	337	TEM-ISO	EMSL04	NOT QC	Direct	10/28/2011	11/29/2011	385	0.0132	395	2.19E-04	11	2.4E-03
AD-001888	1	1	Raking (high intensity)	EX-20191	Air	7/21/2011	Field Sample	635	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/23/2011	9/15/2011	346	0.0099	926	2.38E-04	25	5.9E-03
AD-001888	1	1	Digging (high intensity)	EX-20193	Air	7/21/2011	Field Sample	632	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/23/2011	9/15/2011	346	0.0099	60	3.69E-03	25	9.2E-02
AD-001888	1	1	Mowing (high intensity)	EX-20195	Air	7/21/2011	Field Sample	653	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/23/2011	9/15/2011	346	0.0099	407	2.63E-03	25	6.6E-02
AD-001888	1	2	Digging/mowing/raking (low intensity)	EX-20413	Air	8/5/2011	Field Sample	315	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/6/2012	1/13/2012	360	0.013	119	7.39E-03	26	1.9E-01
AD-001888	1	2	Raking (high intensity)	EX-20414	Air	8/5/2011	Field Sample	632	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/6/2012	1/16/2012	360	0.013	152	2.88E-03	23	6.6E-02
AD-001888	1	2	Digging (high intensity)	EX-20417	Air	8/5/2011	Field Sample	621	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/6/2012	1/13/2012	360	0.013	1540	2.90E-03	0	0
AD-001888	1	2	Mowing (high intensity)	EX-20420	Air	8/5/2011	Field Sample	269	TEM-ISO	EMSL19	NOT QC	Direct	2/6/2012	2/16/2012	385	0.013	505	2.18E-04	19	4.1E-03
AD-001893	4	1	Digging/mowing/raking	EX-20263	Air	7/28/2011	Field Sample	411	TEM-ISO	EMSL27	NOT QC	Direct	11/16/2011	12/7/2011	385	0.013	330	2.18E-04	0	0
AD-001893	4	2	Digging/mowing/raking	EX-20389	Air	8/8/2011	Field Sample	322	TEM-ISO	EMSL27	NOT QC	Direct	1/3/2012	1/12/2012	385	0.013	429	2.14E-04	0	0
AD-001893	4	3	Digging/mowing/raking	EX-20548	Air	8/17/2011	Field Sample	412	TEM-ISO	EMSL04	NOT QC	Direct	12/8/2011	12/9/2011	385	0.0132	322	2.20E-04	0	0
AD-001904	4	1	Digging/mowing/raking	EX-20473	Air	8/12/2011	Field Sample	337	TEM-ISO	EMSL04	NOT QC	Direct	12/8/2011	12/28/2011	385	0.0132	396	2.19E-04	0	0
AD-001904	4	2	Digging/mowing/raking	EX-20622	Air	8/30/2011	Field Sample	361	TEM-ISO	EMSL04	NOT QC	Direct	12/7/2011	12/10/2011	385	0.0132	370	2.18E-04	0	0
AD-001904	4	3	Digging/mowing/raking	EX-20710	Air	9/13/2011	Field Sample	413	TEM-ISO	EMSL04	NOT QC	Direct	12/7/2011	12/11/2011	385	0.0132	323	2.19E-04	0	0
AD-001936	1	1	Digging/mowing/raking (low intensity)	EX-20100	Air	7/18/2011	Field Sample	328	TEM-ISO	EMSL04	NOT QC	Direct	10/28/2011	11/2/2011	385	0.0132	405	2.20E-04	0	0

ATTACHMENT 1B. Detailed Results of Air Samples Collected During the 2011 Residential Activity-Based Sampling Investigation

ABS Information				Sample Information					Analysis Information										Results	
Property ID	Scenario	Event	Activity	Sample ID	Matrix	Sample Date	Sample Type	Volume Collected (L)	Analysis Method	Laboratory	Lab QC Type	Prep Method	Prep Date	Analysis Date	EFA (mm^2)	GO Size (mm^2)	GOs Counted	Sensitivity $(cc)^{-1}$	N LA Structures PCME	LA Air Conc. (s/cc) PCME
AD-001936	1	1	Raking (high intensity)	EX-20101	Air	7/18/2011	Field Sample	662	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/22/2011	9/2/2011	346	0.0099	960	2.20E-04	0	0
AD-001936	1	1	Digging (high intensity)	EX-20103	Air	7/18/2011	Field Sample	644	TEM-ISO	EMSL27	NOT QC	Direct	8/15/2011	8/23/2011	385	0.013	210	2.19E-04	0	0
AD-001936	1	1	Mowing (high intensity)	EX-20106	Air	7/18/2011	Field Sample	635	TEM-ISO	EMSL27	NOT QC	Direct	8/15/2011	8/23/2011	385	0.013	210	2.22E-04	0	0
AD-001936	1	2	Digging/mowing/raking (low intensity)	EX-20303	Air	8/1/2011	Field Sample	328	TEM-ISO	EMSL22	NOT QC	Direct	9/22/2011	11/15/2011	385	0.0129	414	2.20E-04	1	2.2E-04
AD-001936	1	2	Raking (high intensity)	EX-20304	Air	8/1/2011	Field Sample	656	TEM-ISO	RESI	NOT QC	Direct	9/8/2011	9/24/2011	385	0.011	244	2.19E-04	0	0
AD-001936	1	2	Digging (high intensity)	EX-20307	Air	8/1/2011	Field Sample	661	TEM-ISO	RESI	NOT QC	Indirect	9/8/2011	9/24/2011	201	0.011	1267	2.18E-04	5	1.1E-03
AD-001936	1	2	Mowing (high intensity)	EX-20309	Air	8/1/2011	Field Sample	656	TEM-ISO	RESI	NOT QC	Direct	11/29/2011	11/30/2011	385	0.01	289	2.03E-04	6	1.2E-03
AD-002171	4	1	Digging/mowing/raking	EX-20284	Air	7/30/2011	Field Sample	423	TEM-ISO	EMSL27	NOT QC	Direct	11/16/2011	12/8/2011	385	0.013	320	2.19E-04	0	0
AD-002171	4	2	Digging/mowing/raking	EX-20398	Air	8/9/2011	Field Sample	345	TEM-ISO	EMSL27	NOT QC	Direct	1/3/2012	1/11/2012	385	0.013	402	2.14E-04	0	0
AD-002171	4	3	Digging/mowing/raking	EX-20560	Air	8/18/2011	Field Sample	464	TEM-ISO	EMSL04	NOT QC	Direct	12/7/2011	12/8/2011	385	0.0132	286	2.20E-04	0	0
AD-002206	5	1	ATV Rider 1	EX-30296	Air	9/16/2011	Field Sample	331	TEM-ISO	EMSL04	NOT QC	Direct	12/16/2011	1/13/2012	385	0.0132	51	1.73E-03	0	0
AD-002206	5	1	ATV Rider 2	EX-30298	Air	9/16/2011	Field Sample	325	TEM-ISO	EMSL04	NOT QC	Direct	12/16/2011	1/13/2012	385	0.0132	52	1.73E-03	0	0
AD-002206	5	2	ATV Rider 1	EX-30285	Air	9/16/2011	Field Sample	315	TEM-ISO	EMSL04	NOT QC	Direct	12/16/2011	12/20/2011	385	0.0132	53	1.75E-03	0	0
AD-002206	5	2	ATV Rider 2	EX-30287	Air	9/16/2011	Field Sample	325	TEM-ISO	EMSL04	NOT QC	Direct	12/16/2011	1/4/2012	385	0.0132	52	1.73E-03	0	0
AD-002206	5	3	ATV Rider 1	EX-30291	Air	9/16/2011	Field Sample	321	TEM-ISO	EMSL04	NOT QC	Direct	12/16/2011	1/4/2012	385	0.0132	52	1.75E-03	0	0
AD-002206	5	3	ATV Rider 2	EX-30293	Air	9/16/2011	Field Sample	325	TEM-ISO	EMSL04	NOT QC	Direct	12/15/2011	1/4/2012	385	0.0132	52	1.73E-03	0	0
AD-002292	4	1	Digging/mowing/raking	EX-20271	Air	7/28/2011	Field Sample	386	TEM-ISO	EMSL27	NOT QC	Direct	11/16/2011	12/8/2011	385	0.013	352	2.18E-04	0	0
AD-002292	4	2	Digging/mowing/raking	EX-20382	Air	8/8/2011	Field Sample	122	TEM-ISO	EMSL27	NOT QC	Direct	1/3/2012	1/9/2012	385	0.013	1126	2.16E-04	3	6.5E-04
AD-002292	4	3	Digging/mowing/raking	EX-20552	Air	8/17/2011	Field Sample	364	TEM-ISO	EMSL04	NOT QC	Direct	12/8/2011	12/8/2011	385	0.0132	365	2.20E-04	0	0
AD-002501	2	1	Digging/mowing/raking (low intensity)	EX-20093	Air	7/16/2011	Field Sample	331	TEM-ISO	EMSL19	NOT QC	Direct	8/19/2011	9/6/2011	385	0.0064	831	2.19E-04	0	0
AD-002501	2	2	Digging/mowing/raking (low intensity)	EX-20259	Air	7/30/2011	Field Sample	322	TEM-ISO	EMSL27	NOT QC	Direct	11/14/2011	12/20/2011	385	0.013	429	2.14E-04	1	2.1E-04
AD-002501	2	3	Digging/mowing/raking (low intensity)	EX-20440	Air	8/9/2011	Field Sample	316	TEM-ISO	EMSL27	NOT QC	Direct	12/7/2011	12/13/2011	385	0.013	426	2.20E-04	0	0
AD-002515	2	1	Digging/mowing/raking (low intensity)	EX-20089	Air	7/16/2011	Field Sample	338	TEM-ISO	EMSL19	NOT QC	Direct	8/19/2011	9/6/2011	385	0.0064	810	2.20E-04	0	0
AD-002515	2	2	Digging/mowing/raking (low intensity)	EX-20255	Air	7/30/2011	Field Sample	350	TEM-ISO	EMSL27	NOT QC	Direct	11/14/2011	12/19/2011	385	0.013	397	2.13E-04	9	1.9E-03
AD-002515	2	3	Digging/mowing/raking (low intensity)	EX-20393	Air	8/9/2011	Field Sample	333	TEM-ISO	EMSL27	NOT QC	Direct	12/6/2011	12/8/2011	385	0.013	405	2.20E-04	0	0
AD-002645	5	1	ATV Rider 1	EX-30302	Air	9/17/2011	Field Sample	325	TEM-ISO	EMSL27	NOT QC	Direct	12/7/2011	12/27/2011	385	0.013	55	1.66E-03	0	0
AD-002645	5	1	ATV Rider 2	EX-30304	Air	9/17/2011	Field Sample	325	TEM-ISO	EMSL27	NOT QC	Direct	12/7/2011	12/27/2011	385	0.013	55	1.66E-03	0	0
AD-002645	5	2	ATV Rider 1	EX-30308	Air	9/17/2011	Field Sample	325	TEM-ISO	EMSL27	NOT QC	Direct	12/7/2011	12/27/2011	385	0.013	55	1.66E-03	0	0
AD-002645	5	2	ATV Rider 2	EX-30310	Air	9/17/2011	Field Sample	325	TEM-ISO	EMSL27	NOT QC	Direct	12/7/2011	12/27/2011	385	0.013	55	1.66E-03	0	0
AD-002645	5	3	ATV Rider 1	EX-30314	Air	9/17/2011	Field Sample	325	TEM-ISO	EMSL27	NOT QC	Direct	12/7/2011	12/27/2011	385	0.013	55	1.66E-03	0	0
AD-002645	5	3	ATV Rider 2	EX-30316	Air	9/17/2011	Field Sample	325	TEM-ISO	EMSL27	NOT QC	Direct	12/7/2011	12/27/2011	385	0.013	55	1.66E-03	0	0
AD-002990	2	1	Digging/mowing/raking (low intensity)	EX-20173	Air	7/27/2011	Field Sample	329	TEM-ISO	EMSL27	NOT QC	Direct	11/14/2011	12/7/2011	385	0.013	438	2.06E-04	2	4.1E-04
AD-002990	2	2	Digging/mowing/raking (low intensity)	EX-20445	Air	8/9/2011	Field Sample	124	TEM-ISO	EMSL27	NOT QC	Direct	12/7/2011	1/6/2012	385	0.013	1086	2.20E-04	0	0
AD-002990	2	3	Digging/mowing/raking (low intensity)	EX-20555	Air	8/18/2011	Field Sample	137	TEM-ISO	EMSL27	NOT QC	Direct	12/7/2011	1/9/2012	385	0.013	985	2.19E-04	0	0
AD-003155	4	1	Digging/mowing/raking	EX-20267	Air	7/28/2011	Field Sample	414	TEM-ISO	EMSL27	NOT QC	Direct	11/16/2011	12/7/2011	385	0.013	330	2.17E-04	0	0
AD-003155	4	2	Digging/mowing/raking	EX-20385	Air	8/8/2011	Field Sample	345	TEM-ISO	EMSL27	NOT QC	Direct	1/3/2012	1/5/2012	385	0.013	402	2.14E-04	0	0
AD-003155	4	3	Digging/mowing/raking	EX-20543	Air	8/17/2011	Field Sample	444	TEM-ISO	EMSL04	NOT QC	Direct	12/8/2011	12/9/2011	385	0.0132	300	2.19E-04	0	0
AD-003164	5	1	ATV Rider 1	EX-30061	Air	9/6/2011	Field Sample	136	TEM-ISO	EMSL27	NOT QC	Direct	1/17/2012	1/19/2012	385	0.013	125	1.74E-03	0	0
AD-003164	5	1	ATV Rider 2	EX-30062	Air	9/6/2011	Field Sample	342	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/17/2012	1/19/2012	360	0.013	465	1.74E-03	0	0
AD-003164	5	1	ATV Rider 1	EX-30083	Air	9/7/2011	Field Sample	335	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/17/2012	2/1/2012	360	0.013	1540	5.37E-03	0	0
AD-003164	5	1	ATV Rider 2	EX-30085	Air	9/7/2011	Field Sample	314	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/17/2012	1/20/2012	360	0.013	505	1.75E-03	0	0
AD-003164	5	2	ATV Rider 1	EX-30066	Air	9/6/2011	Field Sample	335	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/17/2012	1/19/2012	360	0.013	480	1.72E-03	0	0
AD-003164	5	2	ATV Rider 2	EX-30068	Air	9/6/2011	Field Sample	335	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/17/2012	1/20/2012	360	0.013	480	1.72E-03	0	0
AD-003164	5	2	ATV Rider 1	EX-30093	Air	9/7/2011	Field Sample	329	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/25/2012	1/27/2012	360	0.013	484	1.74E-03	4	7.0E-03
AD-003164	5	2	ATV Rider 2	EX-30095	Air	9/7/2011	Field Sample	311	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/25/2012	2/1/2012	360	0.013	513	1.74E-03	9	1.6E-02
AD-003164	5	3	ATV Rider 1	EX-30072	Air	9/6/2011	Field Sample	335	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/17/2012	1/30/2012	360	0.013	1540	5.37E-03	0	0
AD-003164	5	3	ATV Rider 2	EX-30074	Air	9/6/2011	Field Sample	335	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/17/2012	1/31/2012	360	0.013	1540	5.37E-03	0	0
AD-003164	5	3	ATV Rider 1	EX-30099	Air	9/7/2011	Field Sample	311	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/25/2012	1/31/2012	360	0.013	257	1.73E-03	7	1.2E-02
AD-003164	5	3	ATV Rider 2	EX-30141	Air	9/7/2011	Field Sample	311	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/25/2012	2/3/2012	360	0.013	731	1.74E-03	8	1.4E-02
AD-004293	4	1	Digging/mowing/raking	EX-20151	Air	7/21/2011	Field Sample	697	TEM-ISO	Hygeia	NOT QC	Indirect - Ashed	8/12/2011	8/16/2011	346	0.0099	608	1.10E-04	1	1.1E-04

ATTACHMENT 1B. Detailed Results of Air Samples Collected During the 2011 Residential Activity-Based Sampling Investigation

ABS Information				Sample Information					Analysis Information										Results	
Property ID	Scenario	Event	Activity	Sample ID	Matrix	Sample Date	Sample Type	Volume Collected (L)	Analysis Method	Laboratory	Lab QC Type	Prep Method	Prep Date	Analysis Date	EFA (mm^2)	GO Size (mm^2)	GOs Counted	Sensitivity $(cc)^{-1}$	N LA Structures PCME	LA Air Conc. (s/cc) PCME
AD-004423	5	1	ATV Rider 2	EX-30147	Air	9/8/2011	Field Sample	136	TEM-ISO	EMSL27	NOT QC	Direct	1/24/2012	1/25/2012	385	0.013	127	1.71E-03	0	0
AD-004423	5	1	ATV Rider 1	EX-30148	Air	9/8/2011	Field Sample	326	TEM-ISO	EMSL27	NOT QC	Direct	1/24/2012	1/25/2012	385	0.013	55	1.65E-03	0	0
AD-004423	5	1	ATV Rider 1	EX-30164	Air	9/9/2011	Field Sample	136	TEM-ISO	EMSL04	NOT QC	Direct	1/25/2012	2/10/2012	385	0.0132	123	1.74E-03	1	1.7E-03
AD-004423	5	1	ATV Rider 2	EX-30165	Air	9/9/2011	Field Sample	326	TEM-ISO	EMSL04	NOT QC	Indirect - Ashed	2/2/2012	2/14/2012	365	0.0132	778	1.74E-03	6	1.0E-02
AD-004423	5	2	ATV Rider 2	EX-30150	Air	9/8/2011	Field Sample	127	TEM-ISO	EMSL27	NOT QC	Direct	1/24/2012	1/25/2012	385	0.013	136	1.71E-03	0	0
AD-004423	5	2	ATV Rider 1	EX-30153	Air	9/8/2011	Field Sample	323	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/22/2012	1/23/2012	360	0.013	495	1.73E-03	3	5.2E-03
AD-004423	5	2	ATV Rider 1	EX-30169	Air	9/9/2011	Field Sample	323	TEM-ISO	EMSL04	NOT QC	Indirect - Ashed	1/25/2012	1/30/2012	365	0.0132	1305	1.75E-03	8	1.4E-02
AD-004423	5	2	ATV Rider 2	EX-30172	Air	9/9/2011	Field Sample	136	TEM-ISO	EMSL04	NOT QC	Indirect - Ashed	2/2/2012	2/12/2012	365	0.0132	931	1.75E-03	4	7.0E-03
AD-004423	5	3	ATV Rider 2	EX-30154	Air	9/8/2011	Field Sample	133	TEM-ISO	EMSL27	NOT QC	Direct	1/24/2012	1/25/2012	385	0.013	130	1.71E-03	0	0
AD-004423	5	3	ATV Rider 1	EX-30157	Air	9/8/2011	Field Sample	320	TEM-ISO	EMSL27	NOT QC	Indirect - Ashed	1/22/2012	1/26/2012	360	0.013	498	1.74E-03	2	3.5E-03
AD-004423	5	3	ATV Rider 1	EX-30176	Air	9/9/2011	Field Sample	323	TEM-ISO	EMSL04	NOT QC	Indirect - Ashed	1/25/2012	1/30/2012	365	0.0132	1519	4.51E-03	3	1.4E-02
AD-004423	5	3	ATV Rider 2	EX-30178	Air	9/9/2011	Field Sample	320	TEM-ISO	EMSL04	NOT QC	Indirect - Ashed	1/25/2012	2/6/2012	365	0.0132	1516	4.56E-03	3	1.4E-02
AD-004749	4	1	Digging/mowing/raking	EX-20223	Air	7/27/2011	Field Sample	431	TEM-ISO	EMSL27	NOT QC	Direct	11/16/2011	12/6/2011	385	0.013	315	2.18E-04	0	0
AD-004749	4	2	Digging/mowing/raking	EX-20426	Air	8/6/2011	Field Sample	369	TEM-ISO	EMSL27	NOT QC	Direct	1/3/2012	1/6/2012	385	0.013	376	2.13E-04	0	0
AD-004749	4	3	Digging/mowing/raking	EX-20520	Air	8/16/2011	Field Sample	384	TEM-ISO	EMSL04	NOT QC	Direct	12/7/2011	12/8/2011	385	0.0132	346	2.20E-04	0	0
AD-005707	5	1	ATV Rider 1	EX-30182	Air	9/12/2011	Field Sample	323	TEM-ISO	EMSL04	NOT QC	Indirect - Ashed	1/25/2012	1/30/2012	365	0.0132	1305	1.75E-03	6	1.0E-02
AD-005707	5	1	ATV Rider 2	EX-30184	Air	9/12/2011	Field Sample	326	TEM-ISO	EMSL04	NOT QC	Direct	1/25/2012	1/31/2012	385	0.0132	52	1.72E-03	0	0
AD-005707	5	2	ATV Rider 1	EX-30188	Air	9/12/2011	Field Sample	323	TEM-ISO	EMSL04	NOT QC	Indirect - Ashed	2/2/2012	2/14/2012	365	0.0132	783	1.75E-03	7	1.2E-02
AD-005707	5	2	ATV Rider 2	EX-30191	Air	9/12/2011	Field Sample	136	TEM-ISO	EMSL04	NOT QC	Direct	1/25/2012	1/30/2012	385	0.0132	123	1.74E-03	0	0
AD-005707	5	3	ATV Rider 1	EX-30194	Air	9/12/2011	Field Sample	323	TEM-ISO	EMSL04	NOT QC	Indirect - Ashed	1/30/2012	2/4/2012	365	0.0132	1318	1.73E-03	10	1.7E-02
AD-005707	5	3	ATV Rider 2	EX-30197	Air	9/12/2011	Field Sample	136	TEM-ISO	EMSL04	NOT QC	Direct	1/23/2012	1/26/2012	385	0.0132	123	1.74E-03	2	3.5E-03

Notes:
ABS - activity-based sampling
ID - identification
QC - quality control
EFA - effective filter area
L - liter
mm - millimeter
GO - grid opening
N - number of asbestos structures
LA - Libby amphibole
Conc. - concentration
TEM - transmission electron microscopy
s/cc - structures per cubic centimeter
PCME - phase contrast microscopy-equivalent
ATV - all-terrain vehicle

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ATTACHMENT 1C. Detailed Results of Air Field Quality Control Samples Collected During the 2011 Residential Activity-Based Sampling Investigation

Property ID	Sample ID	Matrix	Sample Date	Sample Type	Analysis Method	Laboratory	Lab QC Type	Prep Method	Prep Date	Analysis Date	EFA (mm^2)	GO Size (mm^2)	GOs Counted	N LA Structures PCME
AD-000025	EX-20035	Air	7/15/2011	Field Blank	TEM-ISO	Hygeia	NOT QC	Direct	8/10/2011	8/11/2011	385	0.0099	101	0
AD-000146	EX-20515	Air	8/16/2011	Field Blank	TEM-ISO	EMSL27	NOT QC	Direct	1/10/2012	1/10/2012	385	0.013	77	0
AD-000353	EX-20204	Air	7/23/2011	Field Blank	TEM-ISO	Hygeia	NOT QC	Direct	8/10/2011	8/11/2011	385	0.0099	101	0
AD-000662	EX-20295	Air	8/1/2011	Field Blank	TEM-ISO	EMSL27	NOT QC	Direct	11/16/2011	12/8/2011	385	0.013	77	0
AD-000769	EX-20727	Air	9/23/2011	Field Blank	TEM-ISO	EMSL19	NOT QC	Direct	11/8/2011	11/22/2011	385	0.013	77	0
AD-001587	EX-20226	Air	7/28/2011	Field Blank	TEM-ISO	EMSL27	NOT QC	Direct	11/16/2011	12/6/2011	385	0.013	77	0
AD-001731	EX-20481	Air	8/10/2011	Field Blank	TEM-ISO	EMSL27	NOT QC	Direct	12/6/2011	12/8/2011	385	0.013	77	0
AD-001855	EX-30199	Air	9/14/2011	Field Blank	TEM-ISO	EMSL04	NOT QC	Direct	12/17/2011	12/29/2011	385	0.0132	77	0
AD-001864	EX-20135	Air	7/20/2011	Field Blank	TEM-ISO	Hygeia	NOT QC	Direct	8/10/2011	8/11/2011	385	0.0099	101	0
AD-001864	EX-20331	Air	8/3/2011	Field Blank	TEM-ISO	EMSL27	NOT QC	Direct	12/6/2011	12/6/2011	385	0.013	77	0
AD-001904	EX-20621	Air	8/30/2011	Field Blank	TEM-ISO	EMSL27	NOT QC	Direct	1/10/2012	1/10/2012	385	0.013	77	0
AD-002171	EX-20285	Air	7/30/2011	Field Blank	TEM-ISO	EMSL27	NOT QC	Direct	11/16/2011	12/8/2011	385	0.013	77	0
AD-002645	EX-30313	Air	9/17/2011	Field Blank	TEM-ISO	EMSL27	NOT QC	Direct	12/7/2011	12/27/2011	385	0.013	77	0
AD-003164	EX-30098	Air	9/7/2011	Field Blank	TEM-ISO	EMSL04	NOT QC	Direct	1/23/2012	1/26/2012	385	0.0132	77	0

Notes:

ABS - activity-based sampling

ID - identification

QC - quality control

EFA - effective filter area

mm - millimeter

GO - grid opening

N - number of asbestos structures

LA - Libby amphibole

TEM - transmission electron microscopy

PCME - phase contrast microscopy-equivalent

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ATTACHMENT 1D. Detailed Results of Soil Samples Collected During the 2011 Residential Activity-Based Sampling Investigation

Property ID	Scenario	Event	Sample ID	Matrix	Sample Date	Sample Type	Composite (Y/N)	Aliquot	Visible Vermiculite				Analysis Method	Laboratory	Lab QC Type	Analysis Date	LA Conc. (%)	LA Bin
									None	Low	Medium	High						
AD-000013	1	1	EX-20122	Soil	7/19/2011	Field Sample	Yes	30	29	1	0	0	PLM-VE	ESATR8	NOT QC	8/19/2011	TR	B1
AD-000013	1	1	EX-20123	Soil	7/19/2011	Field Sample	Yes	2	1	1	0	0	PLM-VE	ESATR8	NOT QC	8/19/2011	ND	A
AD-000013	1	2	EX-20296	Soil	8/2/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/14/2011	TR	B1
AD-000013	1	2	EX-20297	Soil	8/2/2011	Field Sample	Yes	2	2	0	0	0	PLM-VE	ESATR8	NOT QC	9/14/2011	ND	A
AD-000013	1	3	EX-20464	Soil	8/12/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/14/2011	TR	B1
AD-000013	1	3	EX-20467	Soil	8/12/2011	Field Sample	Yes	2	2	0	0	0	PLM-VE	ESATR8	NOT QC	11/14/2011	ND	A
AD-000025	2	1	EX-20034	Soil	7/15/2011	Field Sample	Yes	30	27	3	0	0	PLM-VE	ESATR8	NOT QC	8/19/2011	TR	B1
AD-000025	2	2	EX-20171	Soil	7/27/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/14/2011	ND	A
AD-000025	2	3	EX-20375	Soil	8/6/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/27/2011	ND	A
AD-000065	1	1	EX-20153	Soil	7/23/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	8/19/2011	ND	A
AD-000065	1	1	EX-20154	Soil	7/23/2011	Field Sample	Yes	2	2	0	0	0	PLM-VE	ESATR8	NOT QC	8/19/2011	ND	A
AD-000065	1	2	EX-20402	Soil	8/4/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	10/3/2011	ND	A
AD-000065	1	2	EX-20406	Soil	8/4/2011	Field Sample	Yes	2	2	0	0	0	PLM-VE	ESATR8	NOT QC	10/3/2011	ND	A
AD-000065	1	3	EX-20592	Soil	8/18/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/11/2011	ND	A
AD-000065	1	3	EX-20601	Soil	8/18/2011	Field Sample	Yes	2	2	0	0	0	PLM-VE	ESATR8	NOT QC	11/11/2011	ND	A
AD-000146	1	1	EX-20074	Soil	7/15/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	8/19/2011	ND	A
AD-000146	1	1	EX-20082	Soil	7/15/2011	Field Sample	Yes	2	2	0	0	0	PLM-VE	ESATR8	NOT QC	8/19/2011	ND	A
AD-000146	1	2	EX-20243	Soil	7/29/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/15/2011	ND	A
AD-000146	1	2	EX-20244	Soil	7/29/2011	Field Sample	Yes	2	2	0	0	0	PLM-VE	ESATR8	NOT QC	9/15/2011	ND	A
AD-000146	1	3	EX-20435	Soil	8/8/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	10/3/2011	ND	A
AD-000146	1	3	EX-20438	Soil	8/8/2011	Field Sample	Yes	2	1	1	0	0	PLM-VE	ESATR8	NOT QC	10/3/2011	TR	B1
AD-000146	2	1	EX-20514	Soil	8/16/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/29/2011	ND	A
AD-000146	2	2	EX-20624	Soil	8/30/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/11/2011	ND	A
AD-000146	2	3	EX-20712	Soil	9/13/2011	Field Sample	Yes	30	29	1	0	0	PLM-VE	ESATR8	NOT QC	11/30/2011	TR	B1
AD-000157	5	1	EX-30020	Soil	8/25/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/28/2011	TR	B1
AD-000157	5	2	EX-30027	Soil	8/25/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/29/2011	TR	B1
AD-000157	5	3	EX-30032	Soil	8/25/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/29/2011	TR	B1
AD-000258	2	1	EX-20028	Soil	7/15/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	8/19/2011	TR	B1
AD-000258	2	2	EX-20164	Soil	7/26/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	8/22/2011	TR	B1
AD-000258	2	3	EX-20371	Soil	8/6/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/27/2011	TR	B1
AD-000262	2	1	EX-20061	Soil	7/14/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	12/19/2011	ND	A
AD-000316	1	1	EX-20117	Soil	7/20/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	8/19/2011	ND	A
AD-000316	1	1	EX-20118	Soil	7/20/2011	Field Sample	Yes	2	2	0	0	0	PLM-VE	ESATR8	NOT QC	8/19/2011	TR	B1
AD-000316	1	2	EX-20328	Soil	8/10/2011	Field Sample	Yes	2	0	2	0	0	PLM-VE	ESATR8	NOT QC	11/14/2011	TR	B1
AD-000316	1	2	EX-20447	Soil	8/10/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/14/2011	ND	A
AD-000316	1	3	EX-20602	Soil	8/22/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/11/2011	ND	A
AD-000316	1	3	EX-20609	Soil	8/22/2011	Field Sample	Yes	2	2	0	0	0	PLM-VE	ESATR8	NOT QC	11/11/2011	TR	B1
AD-000353	4	1	EX-20203	Soil	7/23/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	8/22/2011	ND	A
AD-000353	4	2	EX-20355	Soil	8/4/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/26/2011	ND	A
AD-000353	4	3	EX-20502	Soil	8/15/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/15/2011	ND	A
AD-000414	4	1	EX-20197	Soil	7/23/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	8/22/2011	ND	A

ATTACHMENT 1D. Detailed Results of Soil Samples Collected During the 2011 Residential Activity-Based Sampling Investigation

Property ID	Scenario	Event	Sample ID	Matrix	Sample Date	Sample Type	Composite (Y/N)	Aliquot	Visible Vermiculite				Analysis Method	Laboratory	Lab QC Type	Analysis Date	LA Conc. (%)	LA Bin
									None	Low	Medium	High						
AD-000414	4	2	EX-20346	Soil	8/3/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/26/2011	ND	A
AD-000414	4	3	EX-20471	Soil	8/12/2011	Field Sample	Yes	30	27	3	0	0	PLM-VE	ESATR8	NOT QC	11/14/2011	ND	A
AD-000444	2	1	EX-20001	Soil	7/12/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	8/18/2011	TR	B1
AD-000444	2	2	EX-20212	Soil	7/26/2011	Field Sample	Yes	30	28	2	0	0	PLM-VE	ESATR8	NOT QC	8/22/2011	TR	B1
AD-000444	2	3	EX-20367	Soil	8/5/2011	Field Sample	Yes	30	29	1	0	0	PLM-VE	ESATR8	NOT QC	9/26/2011	ND	A
AD-000662	1	1	EX-20052	Soil	7/18/2011	Field Sample	Yes	2	0	1	1	0	PLM-VE	ESATR8	NOT QC	8/19/2011	<1	B2
AD-000662	1	1	EX-20053	Soil	7/18/2011	Field Sample	Yes	30	25	2	3	0	PLM-VE	ESATR8	NOT QC	8/19/2011	TR	B1
AD-000662	1	2	EX-20286	Soil	8/1/2011	Field Sample	Yes	30	25	4	1	0	PLM-VE	ESATR8	NOT QC	9/14/2011	TR	B1
AD-000662	1	2	EX-20287	Soil	8/1/2011	Field Sample	Yes	2	0	1	1	0	PLM-VE	ESATR8	NOT QC	9/14/2011	TR	B1
AD-000662	1	3	EX-20535	Soil	8/16/2011	Field Sample	Yes	30	17	10	3	0	PLM-VE	ESATR8	NOT QC	11/29/2011	TR	B1
AD-000662	1	3	EX-20536	Soil	8/16/2011	Field Sample	Yes	2	1	0	0	1	PLM-VE	ESATR8	NOT QC	11/30/2011	<1	B2
AD-000769	3	1 [a]	EX-20072	Soil	7/14/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	8/19/2011	TR	B1
AD-000769	3	1 [b]	EX-20240	Soil	7/28/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/15/2011	ND	A
AD-000769	3	2 [a]	EX-20490	Soil	8/11/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/15/2011	TR	B1
AD-000769	3	2 [b]	EX-20578	Soil	8/25/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/30/2011	ND	A
AD-000769	3	3 [a]	EX-20640	Soil	9/10/2011	Field Sample	Yes	30	27	3	0	0	PLM-VE	ESATR8	NOT QC	11/30/2011	TR	B1
AD-000769	3	3 [b]	EX-20726	Soil	9/23/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/23/2011	TR	B1
AD-001587	3	1 [a]	EX-20021	Soil	7/14/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	8/18/2011	TR	B1
AD-001587	3	1 [b]	EX-20225	Soil	7/28/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/14/2011	TR	B1
AD-001587	3	2 [a]	EX-20501	Soil	8/11/2011	Field Sample	Yes	30	27	3	0	0	PLM-VE	ESATR8	NOT QC	11/15/2011	ND	A
AD-001587	3	2 [b]	EX-20616	Soil	8/26/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/11/2011	TR	B1
AD-001587	3	3 [a]	EX-20632	Soil	9/10/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/30/2011	ND	A
AD-001587	3	3 [b]	EX-20716	Soil	9/23/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/23/2011	ND	A
AD-001713	4	1	EX-20213	Soil	7/27/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/14/2011	ND	A
AD-001713	4	2	EX-20361	Soil	8/4/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/26/2011	ND	A
AD-001713	4	3	EX-20506	Soil	8/15/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/15/2011	ND	A
AD-001722	4	1	EX-20220	Soil	7/27/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/14/2011	ND	A
AD-001722	4	2	EX-20424	Soil	8/6/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	10/3/2011	ND	A
AD-001722	4	3	EX-20510	Soil	8/16/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/15/2011	TR	B1
AD-001731	1	1	EX-20040	Soil	7/16/2011	Field Sample	Yes	30	25	4	1	0	PLM-VE	ESATR8	NOT QC	8/19/2011	TR	B1
AD-001731	1	1	EX-20041	Soil	7/16/2011	Field Sample	Yes	2	0	2	0	0	PLM-VE	ESATR8	NOT QC	8/19/2011	TR	B1
AD-001731	1	2	EX-20273	Soil	7/29/2011	Field Sample	Yes	30	27	3	0	0	PLM-VE	ESATR8	NOT QC	9/14/2011	TR	B1
AD-001731	1	2	EX-20274	Soil	7/29/2011	Field Sample	Yes	2	2	0	0	0	PLM-VE	ESATR8	NOT QC	9/14/2011	ND	A
AD-001731	1	3	EX-20400	Soil	8/10/2011	Field Sample	Yes	30	12	14	4	0	PLM-VE	ESATR8	NOT QC	10/3/2011	<1	B2
AD-001731	1	3	EX-20487	Soil	8/10/2011	Field Sample	Yes	2	2	0	0	0	PLM-VE	ESATR8	NOT QC	10/3/2011	TR	B1
AD-001731	2	1	EX-20561	Soil	8/18/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/30/2011	<1	B2
AD-001731	2	2	EX-20612	Soil	8/29/2011	Field Sample	Yes	30	25	5	0	0	PLM-VE	ESATR8	NOT QC	11/11/2011	TR	B1
AD-001731	2	3	EX-20704	Soil	9/13/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/30/2011	<1	B2
AD-001732	2	1	EX-20143	Soil	7/21/2011	Field Sample	Yes	30	29	1	0	0	PLM-VE	ESATR8	NOT QC	8/19/2011	ND	A
AD-001732	2	2	EX-20354	Soil	8/3/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/26/2011	ND	A
AD-001732	2	3	EX-20479	Soil	8/12/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/15/2011	TR	B1

ATTACHMENT 1D. Detailed Results of Soil Samples Collected During the 2011 Residential Activity-Based Sampling Investigation

Property ID	Scenario	Event	Sample ID	Matrix	Sample Date	Sample Type	Composite (Y/N)	Aliquot	Visible Vermiculite				Analysis Method	Laboratory	Lab QC Type	Analysis Date	LA Conc. (%)	LA Bin
									None	Low	Medium	High						
AD-001853	2	1	EX-20010	Soil	7/13/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	8/18/2011	TR	B1
AD-001853	2	2	EX-20179	Soil	7/27/2011	Field Sample	Yes	30	26	4	0	0	PLM-VE	ESATR8	NOT QC	9/14/2011	ND	A
AD-001853	2	3	EX-20364	Soil	8/5/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/26/2011	ND	A
AD-001855	5	1	EX-30001	Soil	8/24/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/28/2011	TR	B1
AD-001855	5	2	EX-30008	Soil	8/24/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/28/2011	ND	A
AD-001855	5	3	EX-30014	Soil	8/24/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/28/2011	ND	A
AD-001855	5	1	EX-30264	Soil	9/14/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	12/1/2011	ND	A
AD-001855	5	2	EX-30270	Soil	9/14/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	12/1/2011	ND	A
AD-001855	5	3	EX-30276	Soil	9/14/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	12/1/2011	ND	A
AD-001864	1	1	EX-20133	Soil	7/20/2011	Field Sample	Yes	2	2	0	0	0	PLM-VE	ESATR8	NOT QC	8/19/2011	TR	B1
AD-001864	1	1	EX-20134	Soil	7/20/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	8/19/2011	TR	B1
AD-001864	1	2	EX-20332	Soil	8/3/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/26/2011	ND	A
AD-001864	1	2	EX-20336	Soil	8/3/2011	Field Sample	Yes	2	2	0	0	0	PLM-VE	ESATR8	NOT QC	9/26/2011	ND	A
AD-001864	1	3	EX-20586	Soil	8/17/2011	Field Sample	Yes	30	27	3	0	0	PLM-VE	ESATR8	NOT QC	11/30/2011	TR	B1
AD-001864	1	3	EX-20591	Soil	8/17/2011	Field Sample	Yes	2	1	1	0	0	PLM-VE	ESATR8	NOT QC	11/30/2011	TR	B1
AD-001867	3	1 [a]	EX-20022	Soil	7/14/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	8/19/2011	ND	A
AD-001867	3	1 [b]	EX-20236	Soil	7/28/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/14/2011	ND	A
AD-001867	3	2 [a]	EX-20494	Soil	8/11/2011	Field Sample	Yes	30	28	2	0	0	PLM-VE	ESATR8	NOT QC	11/15/2011	ND	A
AD-001867	3	2 [b]	EX-20628	Soil	8/26/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/11/2011	ND	A
AD-001867	3	3 [a]	EX-20639	Soil	9/10/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/30/2011	ND	A
AD-001867	3	3 [b]	EX-20721	Soil	9/23/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/23/2011	ND	A
AD-001868	1	1	EX-20107	Soil	7/19/2011	Field Sample	Yes	30	28	2	0	0	PLM-VE	ESATR8	NOT QC	8/19/2011	TR	B1
AD-001868	1	1	EX-20108	Soil	7/19/2011	Field Sample	Yes	2	2	0	0	0	PLM-VE	ESATR8	NOT QC	8/19/2011	TR	B1
AD-001868	1	2	EX-20312	Soil	8/2/2011	Field Sample	Yes	30	28	2	0	0	PLM-VE	ESATR8	NOT QC	9/15/2011	<1	B2
AD-001868	1	2	EX-20316	Soil	8/2/2011	Field Sample	Yes	2	2	0	0	0	PLM-VE	ESATR8	NOT QC	9/15/2011	DET2	C
AD-001868	1	3	EX-20525	Soil	8/15/2011	Field Sample	Yes	30	25	5	0	0	PLM-VE	ESATR8	NOT QC	11/29/2011	<1	B2
AD-001868	1	3	EX-20528	Soil	8/15/2011	Field Sample	Yes	2	2	0	0	0	PLM-VE	ESATR8	NOT QC	11/29/2011	<1	B2
AD-001888	1	1	EX-20187	Soil	7/21/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	8/22/2011	TR	B1
AD-001888	1	1	EX-20188	Soil	7/21/2011	Field Sample	Yes	2	1	1	0	0	PLM-VE	ESATR8	NOT QC	8/22/2011	DET1	C
AD-001888	1	2	EX-20412	Soil	8/5/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	10/3/2011	TR	B1
AD-001888	1	2	EX-20416	Soil	8/5/2011	Field Sample	Yes	2	2	0	0	0	PLM-VE	ESATR8	NOT QC	10/3/2011	ND	A
AD-001888	1	3	EX-20565	Soil	8/19/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/30/2011	TR	B1
AD-001888	1	3	EX-20570	Soil	8/19/2011	Field Sample	Yes	2	2	0	0	0	PLM-VE	ESATR8	NOT QC	11/30/2011	TR	B1
AD-001893	4	1	EX-20261	Soil	7/28/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/13/2011	ND	A
AD-001893	4	2	EX-20387	Soil	8/8/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	10/3/2011	ND	A
AD-001893	4	3	EX-20545	Soil	8/17/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/30/2011	ND	A
AD-001904	4	1	EX-20475	Soil	8/12/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/15/2011	ND	A
AD-001904	4	2	EX-20620	Soil	8/30/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/11/2011	ND	A
AD-001904	4	3	EX-20708	Soil	9/13/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/30/2011	ND	A
AD-001936	1	1	EX-20095	Soil	7/18/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	8/19/2011	ND	A
AD-001936	1	1	EX-20096	Soil	7/18/2011	Field Sample	Yes	2	2	0	0	0	PLM-VE	ESATR8	NOT QC	8/18/2011	ND	A

ATTACHMENT 1D. Detailed Results of Soil Samples Collected During the 2011 Residential Activity-Based Sampling Investigation

Property ID	Scenario	Event	Sample ID	Matrix	Sample Date	Sample Type	Composite (Y/N)	Aliquot	Visible Vermiculite				Analysis Method	Laboratory	Lab QC Type	Analysis Date	LA Conc. (%)	LA Bin
									None	Low	Medium	High						
AD-001936	1	2	EX-20302	Soil	8/1/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/15/2011	ND	A
AD-001936	1	2	EX-20306	Soil	8/1/2011	Field Sample	Yes	2	1	1	0	0	PLM-VE	ESATR8	NOT QC	9/15/2011	ND	A
AD-001936	1	3	EX-20454	Soil	8/11/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/14/2011	ND	A
AD-001936	1	3	EX-20457	Soil	8/11/2011	Field Sample	Yes	2	2	0	0	0	PLM-VE	ESATR8	NOT QC	11/14/2011	ND	A
AD-002171	4	1	EX-20180	Soil	7/30/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/14/2011	ND	A
AD-002171	4	2	EX-20395	Soil	8/9/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	10/3/2011	ND	A
AD-002171	4	3	EX-20557	Soil	8/18/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/30/2011	ND	A
AD-002206	5	2	EX-30283	Soil	9/16/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	12/1/2011	TR	B1
AD-002206	5	3	EX-30289	Soil	9/16/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	12/1/2011	ND	A
AD-002206	5	1	EX-30300	Soil	9/16/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	12/1/2011	TR	B1
AD-002292	4	1	EX-20269	Soil	7/28/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/14/2011	ND	A
AD-002292	4	2	EX-20379	Soil	8/8/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/27/2011	ND	A
AD-002292	4	3	EX-20549	Soil	8/17/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/30/2011	ND	A
AD-002501	2	1	EX-20091	Soil	7/16/2011	Field Sample	Yes	30	29	1	0	0	PLM-VE	ESATR8	NOT QC	8/19/2011	TR	B1
AD-002501	2	2	EX-20257	Soil	7/30/2011	Field Sample	Yes	30	29	1	0	0	PLM-VE	ESATR8	NOT QC	9/15/2011	ND	A
AD-002501	2	3	EX-20442	Soil	8/9/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/14/2011	ND	A
AD-002515	2	1	EX-20087	Soil	7/16/2011	Field Sample	Yes	30	23	6	1	0	PLM-VE	ESATR8	NOT QC	8/19/2011	TR	B1
AD-002515	2	2	EX-20253	Soil	7/30/2011	Field Sample	Yes	30	29	1	0	0	PLM-VE	ESATR8	NOT QC	9/15/2011	TR	B1
AD-002515	2	3	EX-20391	Soil	8/9/2011	Field Sample	Yes	30	28	2	0	0	PLM-VE	ESATR8	NOT QC	10/3/2011	TR	B1
AD-002645	5	1	EX-30306	Soil	9/17/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	12/1/2011	ND	A
AD-002645	5	2	EX-30312	Soil	9/17/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	12/1/2011	ND	A
AD-002645	5	3	EX-30318	Soil	9/17/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	12/1/2011	ND	A
AD-002990	2	1	EX-20175	Soil	7/27/2011	Field Sample	Yes	30	28	2	0	0	PLM-VE	ESATR8	NOT QC	9/14/2011	ND	A
AD-002990	2	2	EX-20446	Soil	8/9/2011	Field Sample	Yes	30	21	5	4	0	PLM-VE	ESATR8	NOT QC	11/14/2011	TR	B1
AD-002990	2	3	EX-20553	Soil	8/18/2011	Field Sample	Yes	30	20	10	0	0	PLM-VE	ESATR8	NOT QC	11/30/2011	TR	B1
AD-003155	4	1	EX-20265	Soil	7/28/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/13/2011	ND	A
AD-003155	4	2	EX-20383	Soil	8/8/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/27/2011	ND	A
AD-003155	4	3	EX-20544	Soil	8/17/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/30/2011	ND	A
AD-003164	5	1	EX-30065	Soil	9/6/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/29/2011	ND	A
AD-003164	5	2	EX-30071	Soil	9/6/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/29/2011	ND	A
AD-003164	5	3	EX-30077	Soil	9/6/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/29/2011	ND	A
AD-003164	5	1	EX-30087	Soil	9/7/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/23/2011	ND	A
AD-003164	5	2	EX-30097	Soil	9/7/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/23/2011	TR	B1
AD-003164	5	3	EX-30143	Soil	9/7/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/23/2011	ND	A
AD-004293	4	1	EX-20147	Soil	7/21/2011	Field Sample	Yes	30	29	1	0	0	PLM-VE	ESATR8	NOT QC	12/19/2011	ND	A
AD-004423	5	1	EX-30144	Soil	9/8/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/23/2011	ND	A
AD-004423	5	2	EX-30158	Soil	9/8/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/23/2011	ND	A
AD-004423	5	3	EX-30159	Soil	9/8/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/28/2011	ND	A
AD-004423	5	1	EX-30167	Soil	9/9/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/28/2011	TR	B1
AD-004423	5	2	EX-30173	Soil	9/9/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/28/2011	TR	B1
AD-004423	5	3	EX-30180	Soil	9/9/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/28/2011	ND	A

ATTACHMENT 1D. Detailed Results of Soil Samples Collected During the 2011 Residential Activity-Based Sampling Investigation

Property ID	Scenario	Event	Sample ID	Matrix	Sample Date	Sample Type	Composite (Y/N)	Aliquot	Visible Vermiculite				Analysis Method	Laboratory	Lab QC Type	Analysis Date	LA Conc. (%)	LA Bin
									None	Low	Medium	High						
AD-004749	4	1	EX-20221	Soil	7/27/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/14/2011	ND	A
AD-004749	4	2	EX-20428	Soil	8/6/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	10/3/2011	ND	A
AD-004749	4	3	EX-20518	Soil	8/16/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/29/2011	ND	A
AD-005707	5	1	EX-30186	Soil	9/12/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/28/2011	ND	A
AD-005707	5	2	EX-30192	Soil	9/12/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/28/2011	ND	A
AD-005707	5	3	EX-30198	Soil	9/12/2011	Field Sample	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/28/2011	ND	A

Notes:

[a] Sample was collected prior to irrigation.

[b] Sample was collected after irrigation.

ABS - activity-based sampling

ID - identification

QC - quality control

LA - Libby amphibole

Conc. - concentration

ND - not detected (Bin A)

Tr - trace (Bin B1)

<1% - less than 1% (Bin B2)

PLM-VE - polarized light microscopy, visual area estimation

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ATTACHMENT 1E. Detailed Results of Soil Field Quality Control Samples Collected During the 2011 Residential Activity-Based Sampling Investigation

Property ID	Sample ID	Sample Parent ID	Matrix	Sample Date	Sample Type	Composite (Y/N)	Aliquot	Visible Vermiculite				Analysis Method	Laboratory	Lab QC Type	Analysis Date	LA Conc. (%)	LA Bin
								None	Low	Medium	High						
AD-000013	EX-20124	EX-20122	Soil	7/19/2011	Field Duplicate	Yes	30	29	1	0	0	PLM-VE	ESATR8	NOT QC	8/19/2011	TR	B1
AD-000414	EX-20347	EX-20346	Soil	8/3/2011	Field Duplicate	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	9/26/2011	ND	A
AD-000444	EX-20002	EX-20001	Soil	7/12/2011	Field Duplicate	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	8/18/2011	TR	B1
AD-001587	EX-20717	EX-20716	Soil	9/23/2011	Field Duplicate	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/23/2011	TR	B1
AD-001732	EX-20480	EX-20479	Soil	8/12/2011	Field Duplicate	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/15/2011	ND	A
AD-001855	EX-30002	EX-30001	Soil	8/24/2011	Field Duplicate	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/28/2011	ND	A
AD-001867	EX-20722	EX-20721	Soil	9/23/2011	Field Duplicate	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/23/2011	ND	A
AD-002171	EX-20396	EX-20395	Soil	8/9/2011	Field Duplicate	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	10/3/2011	ND	A
AD-004423	EX-30174	EX-30173	Soil	9/9/2011	Field Duplicate	Yes	30	30	0	0	0	PLM-VE	ESATR8	NOT QC	11/28/2011	ND	A

Notes:

ABS - activity-based sampling

ID - identification

QC - quality control

LA - Libby amphibole

Conc. - concentration

ND - not detected (Bin A)

Tr - trace (Bin B1)

<1% - less than 1% (Bin B2)

PLM-VE - polarized light microscopy, visual area estimation

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